

# Global Energy Innovations EC1000™ & EC2000™ Handheld Battery Analyzers *Firmware Version 2.0.0 Onward*

*Users Manual*

October, 2011 Revision 1.0.3  
© 2009-2011 Global Energy Innovations, All rights reserved.  
Printed in the USA.  
All product names are trademarks of the respective companies.  
Document: EN-1005-1001



## 1. LIMITED WARRANTY & LIMITATION OF LIABILITY

Subject to the exclusions contained below, Global Energy Innovations warrants its EC1000™ and EC2000™ Analyzers (“Products”), Global Energy Innovations-branded or certified accessories sold for use with these Products (“Accessories”) and Global Energy Innovations software contained on CD-Roms or other tangible media and sold for use with these Products (“Software”) to be free from defects in materials and workmanship under normal consumer usage for the period(s) outlined below. This limited warranty is a consumer’s exclusive remedy, and applies as follows to new Products, Accessories and Software purchased by consumers, which are accompanied by this written warranty:

PRODUCTS COVERED	LENGTH OF COVERAGE
<b>Products as defined above.</b>	<b>One (1) year</b> from the date of purchase by the first consumer purchaser of the product.
<b>Accessories as defined above.</b>	<b>One (1) year</b> from the date of purchase by the first consumer purchaser of the product.
<b>Products or Accessories that are Repaired or Replaced.</b>	<b>The balance of the original warranty or for ninety (90) Days</b> from the date returned to the consumer, whichever is longer.
<b>Software</b> as defined above. Applies only to physical defects in the media that embodies the copy of the software (e.g. CD-ROM).	<b>Ninety (90) days from the date of purchase.</b>

### What is not covered? (Exclusions)

**Normal Wear and Tear.** Periodic maintenance, repair and replacement of parts due to normal wear and tear are excluded from coverage.

**Ornamental Decorations.** Ornamental decorations such as emblems and graphics, and other decorative elements, are excluded from coverage.

**Batteries.** Only batteries whose fully charged capacity falls below 60% of their rated capacity and batteries that leak are covered by this limited warranty.

**Abuse & Misuse.** Defects or damage that result from: (a) improper operation, storage, misuse or abuse, accident or neglect, such as physical damage (cracks, scratches, etc.) to the surface of the product resulting from misuse; (b) contact with liquid, water, rain, extreme humidity or heavy perspiration, sand, dirt or the like, extreme heat, or food; (c) Subjecting the Product or Accessory to abnormal usage or conditions; or (d) other acts which are not the fault of Global Energy Innovations, are excluded from coverage.

**Use of Non-Global Energy Innovations Products and Accessories.** Defects or damage that result from the use of Non-Global Energy Innovations branded or certified Products, Accessories, Software or other peripheral equipment are excluded from coverage.

**Unauthorized Service or Modification.** Defects or damages resulting from service, testing, adjustment, installation, maintenance, alteration, including without limitation, software changes, or modification in any way by someone other than Global Energy Innovations, or its authorized service centers, are excluded from coverage.

**Altered Products.** Products or Accessories with (a) serial numbers or date tags that have been removed, altered or obliterated; (b) broken seals or that show evidence of tampering; (c) mismatched board serial numbers; or (d) nonconforming or non- Global Energy Innovations housings, cases, or parts, are excluded from coverage.

**Software Embodied in Physical Media.** No warranty is made that the software will meet your requirements or will work in combination with any hardware or software applications provided by third parties, that the operation of the software products will be uninterrupted or error free, or that all defects in the software products will be corrected.

**Software NOT Embodied in Physical Media.** Software that is not embodied in physical media (e.g. software that is downloaded from the internet), is provided “as is” and without warranty.

**Who is covered?** This warranty extends only to the first consumer purchaser, and is not transferable.

**What will Global Energy Innovations Do?** Global Energy Innovations, at its option, will at no charge repair, replace or refund the purchase price of any Products, Accessories or Software that does not conform to this warranty. We may use functionally equivalent reconditioned / refurbished / pre-owned or new Products, Accessories or parts. No data, software or applications added to your Product, Accessory or Software, including but not limited to personal contacts, site data, configurations, will be reinstalled. To avoid losing such data, software and applications please create a back up prior to requesting service.

**How to Obtain Warranty Service or Other Information?** To obtain service or information, please contact:

**Your Local Representative or Distributor**

- <http://www.globalei.com/distributorsAndReps.html>

**Global Energy Innovations Customer Services**

- Main Phone Number: +1.415.354.5688
- Facsimile: +1.415.354.5738
- Email: [support@globalei.com](mailto:support@globalei.com)
- Or visit us online at <http://www.globalei.com>

You will receive instructions on how to ship the Products, Accessories or Software, at your expense, to a Global Energy Innovations Authorized Repair Center. To obtain service, you must include: (a) a copy of your receipt, bill of sale or other comparable proof of purchase; (b) a written description of the problem; (c) the name of your distributor or representative, if applicable; and, most importantly; (d) your address and telephone number.

**What Other Limitations Are There?**

ANY IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, SHALL BE LIMITED TO THE DURATION OF THIS LIMITED WARRANTY, OTHERWISE THE REPAIR, REPLACEMENT, OR REFUND AS PROVIDED UNDER THIS EXPRESS LIMITED WARRANTY IS THE EXCLUSIVE REMEDY OF THE CONSUMER, AND IS PROVIDED IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OF IMPLIED. IN NO EVENT SHALL GLOBAL ENERGY INNOVATIONS BE LIABLE, WHETHER IN CONTRACT OR NOT (INCLUDING NEGLIGENCE) FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT, ACCESSORY OR SOFTWARE, OR FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES OF ANY KIND, OR LOSS OF REVENUE OR PROFITS, LOSS OF BUSINESS, LOSS OF INFORMATION OR DATA, SOFTWARE OR APPLICATIONS OR OTHER FINANCIAL LOSS ARISING OUT OF OR IN CONNECTION WITH THE ABILITY OR INABILITY TO USE THE PRODUCTS, ACCESSORIES OR SOFTWARE TO THE FULL EXTENT THESE DAMAGES MAY BE DISCLAIMED BY LAW.

**Some states and jurisdictions do not allow the limitation or exclusion of incidental or consequential damages, or limitation on the length of an implied warranty, so the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights, and you may also have other rights that vary from state to state or from one jurisdiction to another.**

Laws in the United States and other countries preserve for Global Energy Innovations certain exclusive rights for copyrighted Global Energy Innovations software such as the exclusive rights to reproduce and distribute copies of the Global Energy Innovations software. Global Energy Innovations software may only be copied into, used in, and redistributed with, the Products associated with such Global Energy Innovations software. No other use, including without limitation disassembly of such Global Energy Innovations software or exercise of the exclusive rights reserved for Global Energy Innovations, is permitted.

## 2. TABLE OF CONTENTS

1.	LIMITED WARRANTY & LIMITATION OF LIABILITY .....	i
2.	TABLE OF CONTENTS .....	1
3.	DECLARATION OF CONFORMITY .....	4
4.	COPYRIGHT NOTICE .....	5
5.	SAFETY INSTRUCTIONS – INTRODUCTION .....	6
6.	SAFETY PRECAUTIONS .....	7
7.	CAUTION & WARNING STATEMENT .....	8
8.	WARNINGS & OTHER SYMBOLS .....	9
9.	IMPAIRED SAFETY .....	10
10.	LIST OF WARNINGS & SAFETY PRECAUTIONS – GENERAL SAFETY INFORMATION .....	11
11.	UNPACKING THE ANALYZER KIT .....	13
12.	INTRODUCTION.....	17
CHAPTER 1 – INITIAL ANALYZER SETUP .....		18
About this Chapter.....		18
Background .....		18
Setup Methods .....		19
Setup Method 1 – Using IBMS.....		19
Setup Method 2 – Using The Analyzer .....		19
Setting up the Analyzer – Getting Started .....		20
Powering ON .....		20
Powering OFF.....		21

The Analyzer Display Screen.....	22
The MAIN MENU .....	22
The UTILITIES MENU .....	23
CHAPTER 2 – ANALYZER TEST CONFIGURATION & TESTING .....	25
About this Chapter.....	25
TEST CONFIGURATIONS.....	25
QUICK TEST SETTINGS (TEMPLATES).....	26
COMPANY / REGION.....	32
STRING CONFIGURATIONS.....	32
BATTERY TYPE TEMPLATES.....	38
TEST SETTING TEMPLATES.....	39
ALARM SETTING TEMPLATES.....	39
TESTING.....	41
TESTING USING THE ANALYZER.....	41
CHAPTER 3 – REVIEWING THE TEST RESULTS .....	44
About this Chapter.....	44
CHAPTER 4 – CONNECTING THE ANALYZER TO IBSM™ SOFTWARE .....	46
About this Chapter.....	46
CHAPTER 5 – ADVANCED ANALYZER FEATURES & FUNCTIONS.....	47
About this Chapter.....	47
TOOLS .....	47

BASELINING – ANALYZER (BASELINE UTILITY).....	47
REPEATABILITY UTILITY .....	51
BATTERY REPLACEMENT UTILITY .....	52
AUTO CALIBRATION.....	54
MASTER RESET .....	54
EJECT SD CARD .....	55
SYSTEM DIAGNOSTICS .....	55
TEMPERATURE MEASUREMENTS & CORRECTION.....	55
ANALYZER / IBMS INTERACTION .....	55
CHAPTER 6 – TROUBLESHOOTING.....	57
About this Chapter.....	57
FIRMWARE UPGRADES .....	57
CRASH RECOVERY .....	57
ANALYZER SPECIFICATIONS .....	58
INDEX .....	64
APPENDICES .....	67

### 3. DECLARATION OF CONFORMITY

Based on the test results using appropriate standards, the EC1000™ and EC2000™ Handheld Battery Analyzers are in conformity with the following:

- Electromagnetic Compatibility Directive 2004/108/EC
- Low Voltage Directive 2006/95/EC



Conformity is indicated by the CE symbol ("Conformité Européenne").

- Subpart B of Part 15 of the FCC Rules (CFR Title 47)
- ICES-003, Issue 4





## 4. COPYRIGHT NOTICE

**Information in this document is subject to change without notice.**

**© Global Energy Innovations. All rights reserved.**

Reproduction in any manner whatsoever without the written permission of Global Energy Innovations is strictly forbidden.

**No Warranty.** This user manual is being delivered to you “as is” and Global Energy Innovations makes no warranty as to its accuracy or use. Any use of this documentation or the information contained therein is at the risk of the user. This documentation may include technical or other inaccuracies or typographical errors. Global Energy Innovations reserves the right to make changes without prior notice. Although every effort has been made to assure the accuracy of the representations of the EC1000™ and EC2000™ Analyzer screen displays within this manual, last minute changes and alterations may lead to slight differences in the information held within this manual and the actual display.

### **Trademarks**

Global Energy Innovations, The GEI logo, Dynapulse™, IBMS™, CELScan™ are trademarks of Global Energy Innovations.

## 5. SAFETY INSTRUCTIONS – INTRODUCTION

Read these pages carefully before beginning to unpack or use the EC1000™ and EC2000™ Analyzer.

The following paragraphs contain information, cautions and warning which must be followed to ensure safe operation and to keep the EC1000™ and EC2000™ Analyzer in safe condition.

### **WARNING**

**Servicing described in this manual is to be done ONLY by qualified service personnel. To avoid electrical shock, DO NOT service the EC1000™ or EC2000™ Analyzers unless you are qualified to do so.**

### **WARNING**

**DO NOT use the EC1000™ or EC2000™ Analyzers unless you have been formally trained at servicing electrical power systems including battery and other energy storage devices.**

## **6. SAFETY PRECAUTIONS**

For the correct and safe use of the EC1000™ and EC2000™ Analyzer, it is essential that both operating and service personnel follow generally accepted safety procedures in addition to the safety precautions specified in this manual. Specific warning and caution statements, where they apply, will be found throughout the manual.

## 7. CAUTION & WARNING STATEMENT

### WARNING

Used to alert the user to the possibility of performing an incorrect maneuver which could lead to damage or destruction of the equipment or other property.

### CAUTION

Used to call attention to a potential danger that requires correct procedures or practices to prevent property damage, personal injury, or death.

## 8. WARNINGS & OTHER SYMBOLS

### Nomenclature and Formatting in this Manual

The following safety symbols are used in the Users Manual.

### Notes, Warnings and Caution Symbols



**NOTE:** A note indicates important information that helps you make better use of your equipment.



**WARNING:** A WARNING used to alert the user to the possibility of performing an incorrect maneuver which could lead to damage or destruction of the equipment or other property.



**CAUTION:** A CAUTION calls attention to a potential danger that requires correct procedures or practices to prevent property damage, personal injury, or death.

## **9. IMPAIRED SAFETY**

Whenever it is likely that safety has been impaired or compromised, the Analyzer must be turned off. The matter should be referred to a qualified technician. Safety is likely to be impaired if, for example, the EC1000™ and EC2000™ Analyzer fails to perform the intended procedure or shows visible damage.

## 10. LIST OF WARNINGS & SAFETY PRECAUTIONS – GENERAL SAFETY INFORMATION

Please read all of the following Warnings before operating your Analyzer.

### GENERAL SAFETY INFORMATION



#### CAUTION

**Disassembling the Analyzer or removing parts, is likely to expose live parts which can be dangerous to life.**

### WARNING / AND SAFETY PRECAUTIONS


#### GENERAL

1. Do not use or operate the Analyzer unless you have been formally trained at servicing electrical power systems including battery and other energy storage devices.
2. Before using the Analyzer, be sure to read all instructions and **CAUTIONS** in this manual, printed on the unit, and on the battery.
3. Before using the Analyzer, read all instructions and cautionary markings on 1) the Analyzer, 2) the battery and 3) the product that uses the battery.
4. The Analyzer must only be serviced by Global Energy Innovations' approved service center. **DO NOT** attempt to open the Analyzer.
5. Avoid contact with the metal surfaces of the Kelvin clips when testing batteries or cells. The Analyzer emits current at various frequencies and current levels during a test sequence. Although the impedance of the human body is very high with little risk of large currents passing through the human body, the user should exercise caution when using the Analyzer as with all other AC emitting devices
6. While testing, **NEVER** connect the Analyzer to a PC or laptop via the USB port. When the PC is using an AC power supply, the USB port connection can cause a ground-loop with dangerous potentials that can disrupt the operation of the Analyzer and potentially harm the operator. Even if the PC is a laptop that is not connected to the AC mains and is using only its own internal battery, it is possible for high voltages to appear between the laptop's GROUND (e.g. any exposed metal parts) and the actual earth ground potential at the test site.
7. While testing, **NEVER** disconnect the Analyzer from the battery or cell that is being tested and reconnect the Analyzer to a voltage source that is greater than 20V. When the Analyzer starts a test cycle the high voltage protection is disabled. Connecting to voltage sources greater than 20V in this state may damage the unit.
8. Hydrogen gas can be present near batteries that are charging and operating with the Analyzer. Always operate your System in a well-ventilated area. **NEVER** smoke or allow a spark or flame in the vicinity of the battery.
9. It is recommended that you have baking soda ( $\text{NaHCO}_3$ ) and water available to absorb (neutralize) any battery electrolyte that may leak or bubble from the battery.
10. Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.

11. Wear complete eye protection and clothing protection and always avoid touching your eyes while working near lead acid batteries.
12. If battery acid contacts your skin or clothing, wash immediately with soap and water. If acid enters your eyes, immediately flood eyes with running cold water for at least 10 minutes and get medical attention immediately.
13. **DO NOT** expose the Analyzer to rain, snow or other harsh environmental conditions.
14. Remove all personal metal items (i.e. necklaces, rings, watches, bracelets, etc.) when working with lead-acid batteries and the Analyzer. Batteries can produce a short circuit current high enough to vaporize or melt a ring (or similar).
15. Take precautions to **NOT** drop any metal tools onto the battery or battery terminals. Metal can cause sparking or short circuit battery or other electrical devices. All tools used in or around a battery should be properly insulated.
16. Before using the Analyzer, ensure that someone is within range of your voice or close enough to come to your aid when you work near a lead-acid battery.
17. Before cleaning the Analyzer, disconnect the unit from all cables (computer connection cable, Kelvin clips, charger cable). Clean your unit using a soft cloth that has been dampened with water. Do not use liquid or aerosol cleaners, which may contain flammable substances.
18. Avoid subjecting your Analyzer to hard knocks or mechanical shocks such as dropping it on hard surfaces.
19. When travelling, store the Analyzer in the supplied carrying case to avoid damage.
20. When moving your Analyzer between environments of differing temperature and humidity levels, condensation may form on and inside the casing. Allow the Analyzer sufficient time to acclimatize, and all condensation to evaporate before powering it on.

**WORKING IN THE VICINITY OF A LEAD-ACID BATTERY IS DANGEROUS. BATTERIES GENERATE EXPLOSIVE GASES DURING NORMAL BATTERY OPERATION. FOR THIS REASON, IT IS OF THE UTMOST IMPORTANCE THAT EACH TIME BEFORE USING YOUR ANALYZER, YOU READ THIS MANUAL AND FOLLOW THE INSTRUCTIONS EXACTLY.**

## INTERNAL LITHIUM-ION ANALYZER BATTERY

	<i>The handling of the Lithium-Ion Battery pack inside the Analyzer requires caution and misuse or mishandling of the battery pack may cause harm to the user. Failure to follow the instructions below may result in high temperatures, fire or explosion.</i>
---	---

1. Do not expose the battery to temperatures above 60°C (140°F). Do not disassemble or mistreat the battery.
2. Use only Global Energy Innovations supplied chargers and cables.
3. Use only replacement battery packs supplied by Global Energy Innovations.
4. Please contact Global Energy Innovations, or your local dealer if you wish to replace the battery pack in your Analyzer.



## 11. UNPACKING THE ANALYZER KIT

The following items are included in the EC1000™ and EC2000™ test tool kit. **Table 1** is a complete list of standard and options accessories as well as replacement parts, product upgrade and warranty extension options. **Figure 1** shows all standard EC1000™ and EC2000™ Analyzer Kit parts. For images of optional accessories and replacement parts please refer to the Global Energy Innovations Online Store or contact your local distributor.



**Figure 1.0.** EC1000™ and EC2000™ Analyzer Kit.

Item	Part #	Description	Quantity
<b>EQUIPMENT – EC1000™ KIT (Impedance / Voltage): 8656-1000</b>			
1	8656-1000	EC1000™ Handheld ElectroChemical Battery Analyzer	1
2	8600-0004	Kelvin Clips – Standard	1
3	8600-1000	IBMS™ Companion Software – Free Download	1
4	1010-1001	AC Wall Adapter, Battery Charger	1
5	8520-0000	Standard Lithium-Ion Battery Pack	1
6	1010-0002	Infrared Thermometer	1
7	1010-1004	Soft Carrying Case	1
8	1010-1005	Hand Strap	1
9	1010-1006	Shoulder Strap	1
10	1015-1001	USB Cable	1
11	1010-1002	2 GB Mini SD Memory Card	1
<b>EQUIPMENT – EC2000™ KIT (Impedance / Voltage / CELScan: Sulfation / Dryout): 8656-2000</b>			
1	8656-2000	EC2000™ Handheld ElectroChemical Battery Analyzer	1
2	8740-0001	Sulfation / Dryout - CELScan™ Package	1
3	8600-0004	Kelvin Clips – Standard	1
4	8600-1000	IBMS™ Companion Software – Compact Disc	1
5	1010-1001	AC Wall Adapter, Battery Charger	1
6	8520-0000	Standard Lithium-Ion Battery Pack	1
7	1010-0002	Infrared Thermometer	1
8	1010-1004	Soft Carrying Case	1
9	1010-1005	Hand Strap	1
10	1010-1006	Shoulder Strap	1
11	1015-1001	USB Cable	1

12	1010-1002	2 GB Mini SD Memory Card	1
<b>EQUIPMENT – OPTIONAL ACCESSORIES</b>			
1	8600-1002	Hard Carrying Case	1
2	8600-0011	Kelvin Probes - Double Point	1
3	8600-0018	Kelvin Probes – Single Point	1
4	8600-0016	Kelvin Probes – Mini	1
5	8600-0010	Accessory Cable Set	1
6	1010-0005	175 Automobile Inverter	1
7	1010-0006	SD Card Reader	1
8	8520-0001	High Capacity Lithium-Ion Battery Pack	1
<b>REPLACEMENT PARTS</b>			
1	8600-0004	Kelvin Clips – Standard	1
2	4242-2009	Kelvin Clips - Replacement Teeth – 4	1
3	4242-0001	Kelvin Probes (Double Point) - Pointed Replacement Tips – 4	1
4	4242-0002	Kelvin Probes (Double Point) - Waffle Replacement Tips – 4	1
5	4242-0008	Kelvin Probes (Single Point) - Replacement Tips – 2	1
6	8600-1000	IBMS™ Companion Software – Compact Disc	1
7	1010-1001	AC Wall Adapter, Battery Charger	1
8	8520-0000	Standard Lithium-Ion Battery Pack	1
9	1010-0002	Infrared Thermometer	1
10	1010-1004	Soft Carrying Case	1
11	1010-1005	Hand Strap	1
12	1010-1006	Shoulder Strap	1
13	1015-1001	USB Cable	1
14	1010-1002	2 GB Mini SD Memory Card	1
<b>HARDWARE &amp; FIRMWARE UPGRADES</b>			

1	8740-0001	CELScan™ – Sulfation / Dryout: EC1000™ Upgrade	1
2	8740-1001	Oscilloscope (EC1000™ & EC2000™ Compatible)	1
3	8740-1002	Advanced Voltmeter	1
4	8740-1003	AC / DC Current Clamp	1
5	8740-1004	AC / DC Current Shunt	1
7	8740-1005	Thermocouple Probe Module	1
<b>PRODUCT WARRANTY &amp; OTHER</b>			
1	8740-2001	Calibration / Certification - Yearly with Certificate	1
2	8740-3001	Extended Warranty – 1 Year Extension	1
3	8740-3002	Extended Warranty – 2 Year Extension	1

**Table 1.** The complete list of standard and options accessories as well as replacement parts, product upgrade and warranty extension options for the EC1000™ and EC2000™ Analyzers.

## 12. INTRODUCTION

### ***Technology Overview***

Effective management of a battery installation requires timely information not only about which battery units are about to fail but also about the cause(s) of those failures. In aggregate, this information defines the battery state of health (SOH). The EC1000™ and EC2000™ (EC-Series) Analyzers determine SOH from a battery's response to a series of electrical excitation signals. Interpretation of the response is performed in real time by Global Energy Innovations' impedance-based, CELScan™ (Chemical Electrical Layer Scanning) algorithms.

At the heart of the EC-Series Analyzers is a single-board computer running Linux that works together with analog, digital and measurement boards to accomplish noise rejection (using fast Fourier transforms – FFT) and other advanced signal processing tasks.

The technology incorporated in these Analyzers is the most advanced of its kind today.

### ***About this Users Manual***

This Users Manual covers all of the features, function and operation of the EC-Series Analyzers. Often there are detailed descriptions of how a function works with examples. The manual is intended to cover a large amount of information, not all of which may be immediately relevant to your successful operation of the Analyzer. For this reason, you may want to read only key parts and reference others at a later date when appropriate or when a feature or function is not clear.

Since the EC-Series Analyzers were designed to work intimately with the IBMS™ (Intelligent Battery Management System™) Software, there is significant discussion and explanations about IBMS™ in this manual. For a complete review of IBMS™, please reference the IBMS™ Users Manual.

## CHAPTER 1 – INITIAL ANALYZER SETUP

### About this Chapter

This section describes how to initialize and initial setup the Analyzer so it is ready for setting up test configuration and use in the field. This section starts by reference to the various options that are available in the **UTILITIES MENU**. These allow the user to set the time and date, temperature format and other setup parameters that are used throughout the testing sequences.

The **UTILITIES MENU** also contains the **TOOLS** sub-Menu section that will not be covered in this chapter. This Menu is covered in a separate Chapter of this users manual since this Menu contain advanced functions and does not directly pertain to the setup and initialization of the Analyzer.

### Background

This background section gives the user a brief overview of how the Analyzer is typically configured and used. Advanced users may deviate from these typical use conditions as required. If you, however, are using the Analyzer for the first time, it is strongly recommended that you follow the steps and procedures in this Chapter.

The Analyzer was designed to be an integral part of a battery monitoring and maintenance process, particularly for those industries with battery powered back-up systems in multiple locations and regions. When testing multiple batteries, it is important know which test data is from which battery. For this reason, the Analyzer must be configured so that it knows the following information. This information is part of the hierarchy outlined below. **Figure 1.1** shows the Configuration Screen in the Analyzer's companion software, IBMS™ (Intelligent Battery Management System™) Software. It is displayed her to both graphically show the information hierarchy as well as illustrate the similarities between the Analyzer and the IBMS™ configuration options.

### Location Hierarchy

- Company or User (*Company*)
- Geographical Region / Location (*Region*)
- Site Location (*Site*)
- String of Batteries being Tested (*String*)

### Testable Parts and Connections

- Multiple Cell Unit (*Battery*)
- Single Cell Unit (*Cell*)
- Electrical Connection (*Strap*)

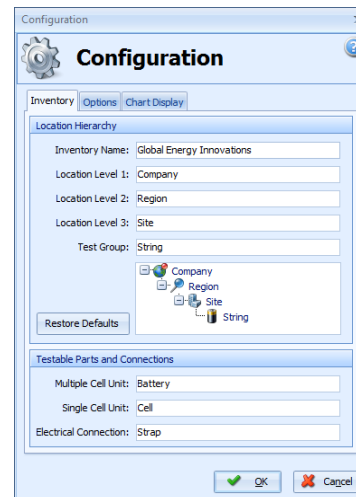


Figure 1.1. IBMS Inventory hierarchy setup screen.

For this reason, the user must either manually enter the required information, or pre-load (via IBMS™) the Analyzer before testing takes commences. Pre-loading (pre-programming) the Analyzer is normally the preferred method of inputting the required information, however, this assumes that the user has prior knowledge of some or all of the information before arriving at the Site where testing will occur. Since this is not always the case, the Analyzer has been designed such that either method will work adequately.

The primary benefit of pre-loading the Analyzer with its configuration information is that this allows the maintenance personnel to simply "call up" the Site and String information and rapidly move into testing.

In addition to the information listed above, the user is prompted to enter additional String Configuration, Test Setting, Battery and other Site and Test specific information prior to testing. Again, all of this information can be either created using the Analyzer or in IBMS and loaded to the Analyzer.

There are some (a limited amount of) setup parameters that are only accessible via IBMS, however, these do not affect the usability of the Analyzer. These features fall into the category of enhanced function / features.

## **Setup Methods**

### **Setup Method 1 – Using IBMS**

The quickest and easiest method of setting up the Analyzer is to use the **Inventory Management** utility in IBMS. This has additional benefits in that a library of configuration files can be developed and stored ready for use at any time. In this way, the configuration of one or more Analyzers is easy and rapid. Simply connect the Analyzer to a PC running IBMS, load in the appropriate configuration file or files and load them to any number of Analyzers connected via USB with a few clicks of the mouse. Multiple pre-programmed sites can be entered into any Analyzer in a matter of seconds. This method of device configuration has the following significant benefits:

- Once a configuration has been defined and stored, it can simply be re-used, saving significant administration time.
- The continuity and integrity of the test data taken by the Analyzer is preserved since each subsequent maintenance visit to each site will be based on exactly the same Site Name, String Name, etc.

### **Setup Method 2 – Using The Analyzer**

The Analyzer can be fully programmed and configured using the keypad shown in **Figure 1.2**. Similar to a mobile or smart phone, the keypad can be used to access and navigate menus, enter data, switch options ON and OFF, etc... This flexibility allows the user to configure the Analyzer anywhere, simply by following the on-screen menus.

The following section explains in detail how the Analyzer is manually programmed. It is recommended that all users read these procedures fully so as to obtain the maximum benefit from the Analyzer and a complete understanding of the necessary set-up procedures.

## Setting up the Analyzer – Getting Started

### Powering ON

The Analyzer is powered OFF by pressing the green power button as shown in **Figure 1.2.1** for several seconds. After the button is pressed, the Analyzer will boot and the welcome splash screen shown in **Figure 1.3** will appear.

Almost immediately after the welcome screen, the Analyzer will go through an automatic calibration process. The progress of this calibration is shown in **Figure 1.4** and will typically complete in several seconds. If there are any faults in the Analyzer, this screen will display an error with details explaining the fault.

The calibration is a multi-stage, auto-calibration sequence that the Analyzer goes through each time it is turned on.

Once the Analyzer has finished calibration, the **MAIN MENU** is displayed (**Figure 1.5**).



Figure 1.2.1 Analyzer keypad layout.



Figure 1.2.2 Keypad functions.



Figure 1.3. Analyzer welcome splash screen.



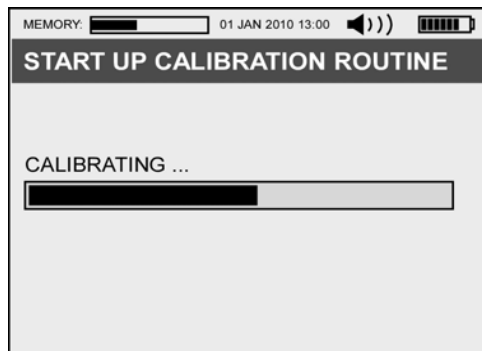


Figure 1.4. Calibration screen.

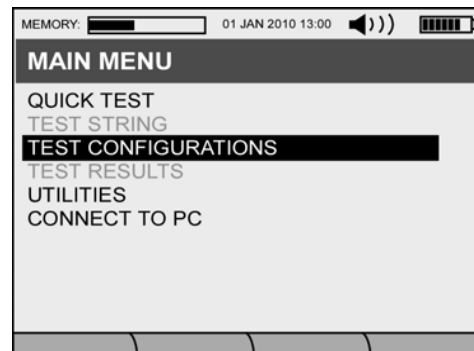


Figure 1.5. Main Menu.

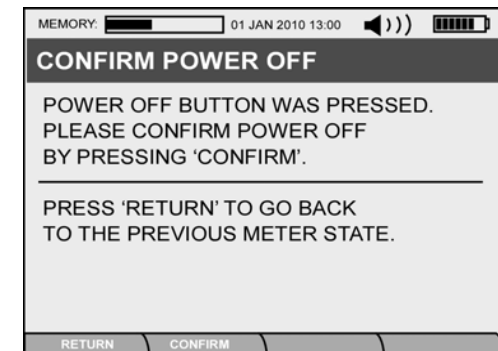


Figure 1.6. Confirm power off screen.

## Powering OFF

The Analyzer is powered OFF by pressing the green power button as shown in **Figure 1.2** for several seconds. After the button is pressed, a **Confirm Power Off** screen (**Figure 1.6**) will show to ensure that the user wants to power the Analyzer OFF. The **F1** key (Return) may be pressed to abort Power OFF and return to the previous screen. During the power off sequence (**Figure 1.7**), any unsaved data is saved and the analyzer properly shuts down.

If for any reason the Analyzer is shut down improperly (i.e. The battery is removed, there is a system crash, etc...) data is normally saved in memory and recovered on the next power ON sequence. **Figure 1.8** shows the system recovery screen that is displayed after an improper Analyzer shut down.

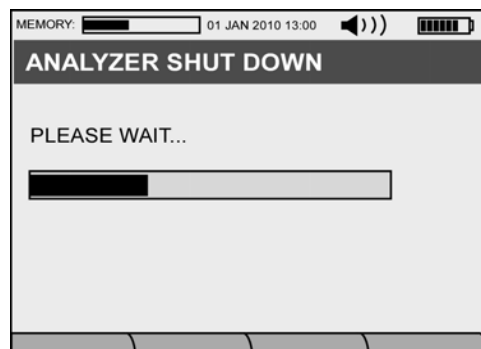


Figure 1.7. Power off sequence.

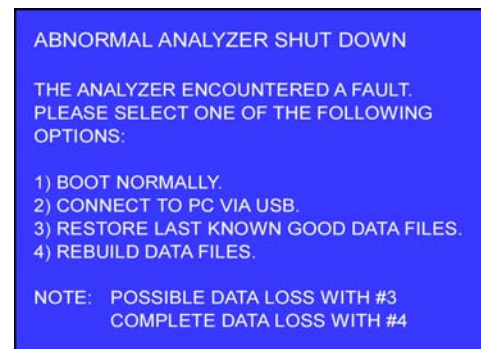


Figure 1.8. System recovery screen.

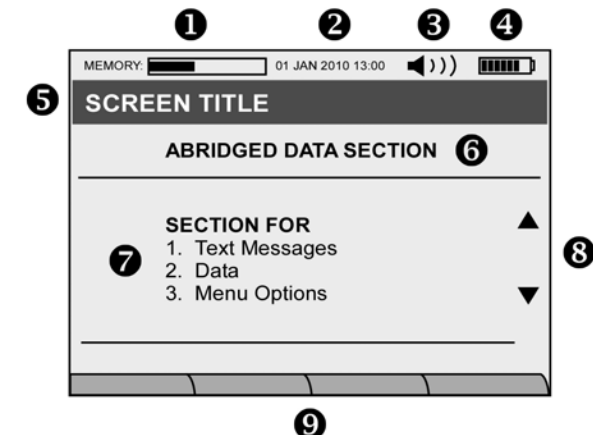


Figure 1.9. Screen layout descriptions.

### **The Analyzer Display Screen**

The Analyzer has a number of various screen types that display menus, results, calculations, etc... Although these screens vary somewhat in their layout, they all share a number of common elements that the user will grow accustomed to during Analyzer operation. **Figure 1.9** illustrates these common elements.

- (1) This icon shows the amount of used and available memory on the SD Card. The user is alerted when memory is near full.
- (2) The time and data are displayed.
- (3) The sound level for the audible alarms and notifications.
- (4) The battery status (state of charge) of the internal lithium-ion battery.
- (5) The title of the screen.
- (6) The abridged data section. Often other notices are also displayed in this area.
- (7) This section is where most of the text messages, data and menu options are displayed.
- (8) UP and DOWN arrows are shown when there is additional data to see in either scroll direction. The navigation buttons (**Figure 1.2**) are used to scroll up and down.
- (9) The four (4) function keys. The text for these keys will change depending on which screen is being displayed.

### **The MAIN MENU**

The Analyzer **MAIN MENU** (**Figure 1.5**) gives the user the following navigation options listed below. In this Chapter, only the **QUICK TESTS**, **TEST CONFIGURATION** and **UTILITIES MENUS** are covered. Some sub **Menus** in these sections are not covered because they do not directly apply to the basic setup and use of the Analyzer.

- (1) **QUICK TESTS**
- (2) **TEST STRING**
- (3) **TEST CONFIGURATION**
- (4) **TEST RESULTS**
- (5) **UTILITIES**
- (6) **CONNECT TO PC**

## The UTILITIES MENU

The Analyzer **UTILITY MENU** (Figure 1.10) is the first Menu that the user should enter and configure. In this Menu, only the **SYSTEM SETTINGS** and **SYSTEM PROFILE** Menus are explored in this section. In future Chapters the other **UTILITY MENU** options are reviewed in detail.

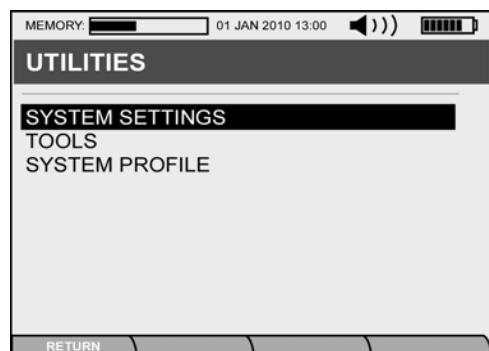


Figure 1.10. Utility Menu.

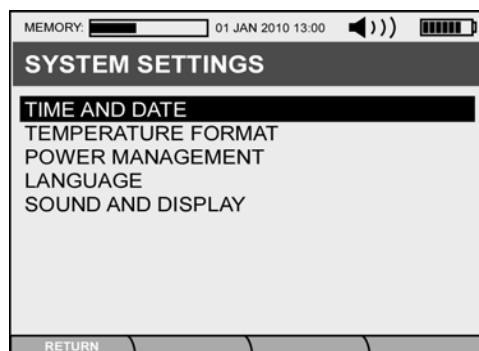


Figure 1.11. System Settings Menu.

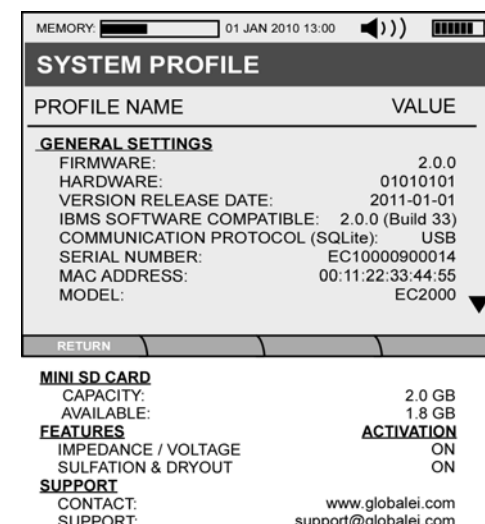


Figure 1.12. System Profile Screen.

The following **SYSTEM SETTINGS** (Figure 1.11) in the **UTILITY MENU** (Figure 1.10) should be configured at this step of setting up the Analyzer. A brief description of each is outlined, however most are fairly self explanatory.

- (1) **TIME AND DATE** – The user should set the date format that they prefer here. This format may later be altered when data is imported into IBMS™.
- (2) **TEMPERATURE FORMAT** – Using the RIGHT and LEFT navigation buttons, the user can select either °C (Celsius) or °F (Fahrenheit).
- (3) **POWER MANAGEMENT** – It is recommended that the AUTO SHUTDOWN feature be turned ON so that the internal lithium-ion battery will not discharge if the power button is accidentally depressed in the Analyzers carrying case. If the Analyzer shuts down, all data is saved, so there is no risk of data or configuration loss with this function enabled.
- (4) **LANGUAGE** – To change language, a custom firmware load is required as indicated on this screen. Please contact your local distributor for details on obtaining language-specific firmware.
- (5) **SOUND AND DISPLAY** – These parameters are set per user preferences.

The **SYSTEM PROFILE** screen (**Figure 1.12**) gives the user all of the Analyzer information. This information is often required if your Analyzer is being upgraded or if you have a question regarding the features that have been activated. Details are listed below.

### **GENERAL SETTINGS**

- 1) **FIRMWARE** – The firmware version running on the Analyzer. Firmware is automatically updated when you connect to IBMS when your PC has a live internet connection and can access the Global Energy Innovations' Activation Server.
- 2) **HARDWARE** – The Analyzer hardware version. This is a code that indicates the versions of the various internal hardware modules.
- 3) **VERSION RELEASE DATE** – The date that the firmware was released from Global Energy Innovations to the field for use.
- 4) **IBMS COMPATIBLE** – The latest version of IBMS™ that is compatible with the firmware currently running on the Analyzer.
- 5) **COMM. PROTOCOL (SQLite)** – The communication protocol used for transferring the SQLite data to and from the Analyzer and IBMS™.
- 6) **SERIAL NUMBER** – Analyzer Serial Number. Since all Analyzers start at the factor as EC1000's™, even if you have an EC2000™, the first six (6) characters will always be EC1000™.
- 7) **MAC ADDRESS** – The MAC (Media Access Control) Address of the Single Board Computer inside the Analyzer. This is a unique identifier and allows Global Energy Innovations to identify the Analyzer via the activation server.
- 8) **MODEL** – The Model of your Analyzer. This can change depending on the features that have been activated or deactivated on the Analyzer.

### **MINI SD CARD**

- 9) **CAPACITY** – The total capacity of the Mini SD Card that is installed in the Analyzer is displayed here. Note: The Mini SD Card must be configured (formatted) with an appropriate setup (backing) file to operate in the Analyzer. Instructions on how to format a standard Mini SD Card can be found on the Customer Support Site (<http://support.globalei.com>).
- 10) **AVAILABLE** – The available (remaining) capacity of the Mini SD Card is displayed here.

### **FEATURES**

- 11) **Impedance / Voltage** – This is the standard EC1000™ feature set for the Analyzer. When this feature is enabled, the Analyzer is capable of testing the electrical properties of batteries only.
- 12) **Sulfation / Dryout** – CELScan™ module for Sulfation and Dryout advanced health algorithms. When **ACTIVATION** is ON, this feature is enabled and will work on the Analyzer. This is only ON for EC2000™ Analyzers. This CELScan™ module also provides additional signal processing capabilities such as Fast Fourier Transform (FFT) analysis and enhanced noise rejection.

### **SUPPORT**

- 13) **SUPPORT** – website for support related matters.
- 14) **CONTACT** – Contact details for support related matters.

## CHAPTER 2 – ANALYZER TEST CONFIGURATION & TESTING

### ***About this Chapter***

This section describes how configure the Analyzer and begin testing. Advanced testing functions are not covered in this Chapter. Refer to Chapter 6 (Advanced Features and Function) for details on going beyond basic setup and testing.

This Chapter covers the following **MAIN MENU** topics:

1. **TEST CONFIGURATIONS**
2. **QUICK TEST**
3. **TEST STRING**

This Chapter begins with **TEST CONFIGURATIONS** because this function allows the user to fully configure and set up the Analyzer in preparation for testing. **QUICK TEST** and **TEST STRING** follow as these functions utilize the previous setup conditions on **TEST CONFIGURATIONS**.

It is assumed that the user has already read the previous Chapter and has performed the basic Analyzer setup functions.

### **TEST CONFIGURATIONS**

**Figure 2.1** shows the **TEST CONFIGURATION** screen. This screen has the sub **Menus** listed below. All of these **Menus** are described in detail in this Chapter. The sub **Menus** are not covers in the order listed below because they a first-time user should get familiar with the logical flow first. After the user has become proficient in setting up testing, it is expected that they will deviate from the this description.

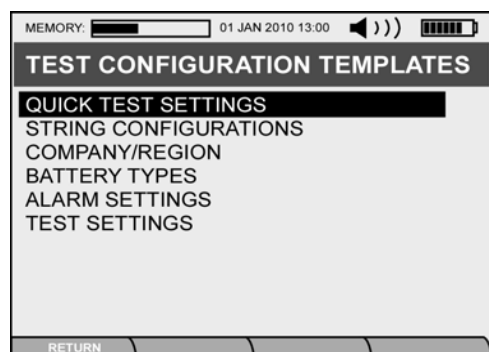
- (1) **QUICK TEST SETTINGS**
- (2) **STRING CONFIGURATIONS**
- (3) **COMPANY / REGION**
- (4) **BATTERY TYPES**
- (5) **ALARM SETTINGS**
- (6) **TEST SETTINGS**

## QUICK TEST SETTINGS (TEMPLATES)

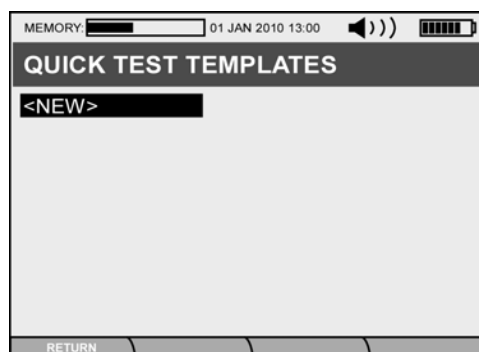
We will first cover **QUICK TEST SETTINGS** because, in the process of running a **QUICK TEST**, the user will be guided through the most basic setup parameters required for testing a battery or cell. In later discussion on setting up **STRING CONFIGURATIONS**, **BATTERY TYPES**, **ALARM SETTINGS** and **TEST SETTINGS**, the user may run **QUICK TEST** with greater ease because some of the **Templates** will have already been configured for use.

In the standard **QUICK TEST** setup, the user does not access the **Templates** but may if desired. Details on setting up **Templates** may be found in this **Chapter** under the **Templates**.

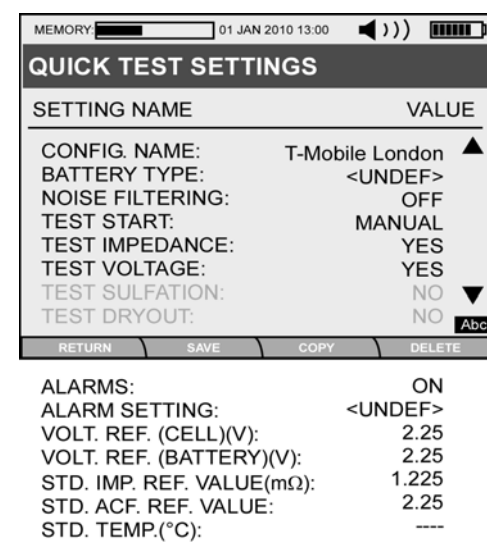
**Figure 2.2** and **2.3** show the two (2) screen required for setting up a **QUICK TEST**.



**Figure 2.1.** Test Configuration Menu.



**Figure 2.2.** Quick Test Template screen.



**Figure 2.3.** Quick Test Settings screen.

When arriving at the **QUICK TEST TEMPLATES** screen (**Figure 2.2**), the user will see <NEW>. Press the <ENTER> button to move to the **QUICK TEST SETTING** screen. You will now need to enter the following information as indicated in **Figure 2.3**. Details on each entry are described in the list below. After completing data entry for all of the sections listed below, you will return to **Figure 2.2**, however, a new **QUICKTEST** name will appear under <NEW>.

- (1) **CONFIG. NAME** – This is the name of the **QUICK TEST** configuration. Entry is accomplished using the Alpha Numeric keys. Use the **ESC** (Back Arrow) to move back and the **SHIFT** keys as needed. A complete description of the key functions are shown in **Figure 1.2.2**.

SETTING NAME	VALUE
MANUFACTURER:	EAST PENN
MODEL:	U1HR1500
TYPE:	VRLA(AGM)
CAPACITY (C/10)Ah :	56.8
TEST LEVEL:	BATTERY
# CELL(S) PER BATTERY:	1

**Figure 2.4.** Battery Type Manu (Battery Details) screen.

(2) **BATTERY TYPE** – This screen lets the user enter the **BATTERY DETAILS** for the battery that is being tested. **Figure 2.4** shows the **BATTERY TYPE** screen. The following data entry is required for this screen:

- **MANUFACTURER:** Battery/Cell Manufacturer.
- **MODEL:** This is the Model number of the Battery/Cell being tested.
- **TYPE:** This is a predefined selection menu. The user selects from the following types using the RIGHT and LEFT navigation buttons:
  - ⇒ **Other**
  - ⇒ **Lead Acid (AGM):** *Absorbed Glass Mat*
  - ⇒ **Lead Acid (Gel)**
  - ⇒ **Lead Acid (Flooded)**
  - ⇒ **Li-Ion:** *Lithium Ion*
  - ⇒ **NiCd:** Nickel Cadmium
  - ⇒ **NiMH:** Nickel Metal Hydride
- **CAPACITY:** Entry of the Capacity of the Battery/Cell being tested. The value is entered at the C/10 (Capacity at a 10-Hour discharge rate) in Amp Hours.
- **TEST LEVEL:** This is a predefined selection menu indicating if the user is testing a Battery or Cell. The user selects from the following test levels using the RIGHT and LEFT navigation buttons:
  - ⇒ Battery: Multi-Cell unit.
  - ⇒ Cell: Single unit.

- **# CELLS(S) PER BATTERY:** Entry of the number of Cells in the Battery being tested. If a single cell is being tested, this value will be one (1), otherwise the user can manually enter a value from 1 to 31 or use the **RIGHT** and **LEFT** navigation buttons to increment or decrement the numeric value.

⊗ Function 1: **Return:** Returns the user to the previous screen without saving data entry.

⊗ Function 2: **Save:** Saves the entered data and returns the user to the previous screen so they can continue with the **QUICK TEST SETTINGS** data entry.

⊗ Function 1: **Template:** Allows the user to select a predefined **BATTERY TEMPLATE**.

*NOTE: Once the user has completed data entry for **BATTERY TYPE**, they are returned to the **QUICK TEST SETTINGS** and **BATTERY TYPE** now shows <EDIT> instead of <UNDEF>. This indicates that data was successfully entered either from manually or from a predefined **BATTERY TEMPLATE**.*

- (3) **NOISE FILTERING** – This is a predefined selection menu for selecting the level of Noise Filtering used during testing. The user selects from the following predefined settings using the **RIGHT** and **LEFT** navigation buttons. Test time may vary depending on the level of noise filtering that is selected.
- ⇒ **Off:** No noise filtering.
  - ⇒ **Low**
  - ⇒ **Medium**
  - ⇒ **High**
  - ⇒ **Auto:** The Analyzer will automatically determine the filtering level based on feedback from testing conditions.
- (4) **TEST START:** This is a predefined selection menu for selecting how the test will start. The user selects from the following predefined settings using the **RIGHT** and **LEFT** navigation buttons.
- ⇒ **Manual:** The user must press the **ENTER** button to start each test.
  - ⇒ **AUTO:** Once the Kelvin Clips are attached to a valid Device Under Test – DUT (Batter/Cell or Strap/Interconnect) the test automatically starts.
- (5) **AUTO-START DELAY (SEC):** When **TEST START** is set to **AUTO**, the user must manually enter a value from 1 to 31 or use the **RIGHT** and **LEFT** navigation buttons to increment or decrement the numeric value. This is the amount of time the user will wait once a Valid DUT is detected.
- (6) **TEST IMPEDANCE:** The user selects if the Analyzer will test the single-point impedance value of the DUT being testing. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.
- (7) **TEST VOLTAGE:** The user selects if the Analyzer will test the voltage of the DUT being testing. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.
- (8) **TEST SULFATION:** The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery sulfation. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO. This function is only active on EC2000™ Analyzers.



- (9) **TEST DRYOUT:** The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery dryout. The RIGHT and LEFT navigation arrows are used for selecting between YES or NO. This function is only active on EC2000™ Analyzers and only for Valve Regulated Lead-Acid Batteries/Cells (Lead Acid – AGM and Lead Acid – Gel).
- (10) **ALARMS:** The user selects if the Alarms will be active during testing. The RIGHT and LEFT navigation arrows are used for selecting between YES and NO.
- (11) **ALARM SETTING:** This screen lets the user enter the **ALARM SETTINGS** for the testing. **Figure 2.5** shows the **ALARM SETTINGS** screen. The following data entry is required for this screen:

ALARM SETTINGS	
SETTING NAME	VALUE
<b>IMPEDANCE ALARMS</b>	
IMPEDANCE HIGH (%)	
Warning Value:	117.0
Warning ON/OFF:	ON
Fail Value:	125.0
Fail ON/OFF:	ON
<b>IMPEDANCE LOW (%)</b>	
Warning Value:	70.0
Warning ON/OFF:	ON
Fail Value:	50.0
Fail ON/OFF:	ON
<b>VOLTAGE ALARMS</b>	
VOLTAGE HIGH (V)	
Warning Value:	2.30
Warning ON/OFF:	ON
Fail Value:	2.35
Fail ON/OFF:	ON
VOLTAGE LOW (V)	
Warning Value:	2.20
Warning ON/OFF:	ON
Fail Value:	2.15
Fail ON/OFF:	ON
<b>CELSCAN ALARMS</b>	
SULFATION (%)	
Warning Value:	15
Warning ON/OFF:	ON
Fail Value:	20
Fail ON/OFF:	ON
DRYOUT (%)	
Warning Value:	15
Warning ON/OFF:	ON
Fail Value:	20
Fail ON/OFF:	ON
<b>STRAP ALARMS</b>	
STRAP (%)	
Warning Value:	150.0
Warning ON/OFF:	OFF
Fail Value:	200.0
Fail ON/OFF:	OFF

**Figure 2.5.** Alarm Settings screen.

**IMPEDANCE ALARMS:** Alarms for single-point impedance testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

- **IMPEDANCE HIGH (%):** This is the impedance alarm above (greater than) the baseline value. Values are entered manually or with the RIGHT and LEFT navigation buttons. Default values are set on the Analyzer when entering this section.
  - ⇒ **Warning Value:** This is the warning value as specified as a percentage measured from the baseline value.
  - ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- ⇒ **Fail Value:** This is the fail value as specified as a percentage measured from the baseline value.
- ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**IMPEDANCE LOW (%):** This is the impedance alarm below (less than) the baseline value. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.

- ⇒ **Warning Value:** This is the warning value as specified as a percentage measured from the baseline value.
- ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
- ⇒ **Fail Value:** This is the fail value as specified as a percentage measured from the baseline value.
- ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**VOLTAGE ALARMS:** Alarms for voltage testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

- **VOLTAGE HIGH (V):** This is the voltage alarm above (greater than) the pre-entered reference value. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.
  - ⇒ **Warning Value:** This is the warning value as specified as a discrete value.
  - ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - ⇒ **Fail Value:** This is the fail value as specified as a discrete value.
  - ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**VOLTAGE LOW (V):** This is the voltage alarm below (less than) the pre-entered reference value. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section

- ⇒ **Warning Value:** This is the warning value as specified as a discrete value.
- ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
- ⇒ **Fail Value:** This is the fail value as specified as a discrete value.
- ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**CELSCAN ALARMS:** Alarms for CELScan testing results - Sulfation and Dryout. Default values are shown on the Analyzer when entering this screen.

- **SULFATION (%):** These values represent the percentage (%) of capacity loss due to battery/cell sulfation. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell, due to battery/cell sulfation, the alarm would be reached. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.
  - ⇒ **Warning Value:** This is the warning value as specified as a percentage.
  - ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- ⇒ **Fail Value:** This is the fail value as specified as a percentage.
  - ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - **DRYOUT (%):** These values represent the percentage (%) of capacity loss due to battery/cell dryout. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell due to battery/cell dryout, the alarm would be reached. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.
    - ⇒ **Warning Value:** This is the warning value as specified as a percentage.
    - ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
    - ⇒ **Fail Value:** This is the fail value as specified as a percentage.
    - ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
- STRAP ALARMS:** These are alarms for strap testing results. Default values are shown on the Analyzer when entering this screen.
- ⇒ **Warning Value:** This is the warning value as specified as a percentage above the baseline value.
  - ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
  - ⇒ **Fail Value:** This is the fail value as specified as a percentage above the baseline value.
  - ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.
- (12) **VOLT. REF. (CELL)(V):** The user enters the Voltage Reference Value for the Cell. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for **VOLT. REF. (BATTERY) (V)** is automatically calculated. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.
- (13) **VOLT. REF. (BATTERY)(V):** The user enters the Voltage Reference Value for the Battery. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for **VOLT. REF. (CELL) (V)** is automatically calculated. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.
- Note: Either CELL or BATTERY reference values may be enter first and the other is automatically calculated.*
- (14) **STD. IMP. REF. VALUE (mΩ):** This is the Standard Impedance Reference Value in mOhms that will used for all Impedance Alarm calculations. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.
- (15) **STD. ACF. REF. VALUE:** The user enters the Standard Algorithm Calibration Factor used with the CELScan Algorithms – Sulfation and Dryout). This value will be used for Sulfation and Dryout algorithm calibrations and adjustments. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.

This value is typically calculated using the **BASELINE UTILITY** in the **UTILITIES** → **TOOLS Menu**. Details on the ACF and proper ACF generation procedure, please reference the Chapter 7.

The user has now completed the **QUICK TEST** setup.

### **COMPANY / REGION**

**COMPANY / REGION** is covered next, because this value is used in the **STRING CONFIGURATION**. This section allows the user to manually enter a **COMPANY** name (i.e. The name of the Company that owns the sites that are being tested. Example – Southern California Edison). The **REGION** is the name of the Region where testing occurs.

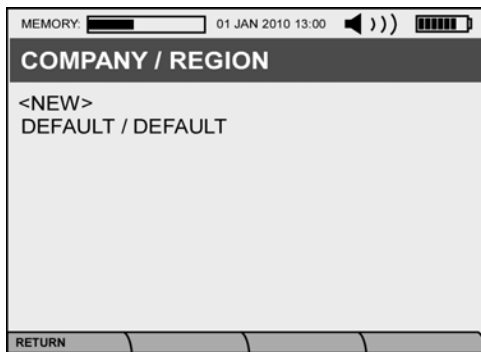


Figure 2.6. Company/Region screen 1.



Figure 2.7. Company/Region screen 2.

**Figure 2.6** and **2.7** show the two screen for entering the appropriate data. Follow the screens for appropriate data entry. The correct **COMPANY** and **REGION** must be entered prior to testing, otherwise, these values will not properly load to IBMS™ for review and archiving.

### **STRING CONFIGURATIONS**

The **STRING CONFIGURATION Menu** and accompanying screens are the most complex and all-encompassing screen flow in the Analyzer. A user can select **STRING CONFIGURATION** and use this Menu exclusively to set up and entire test. **STRING CONFIGURATION** accesses most all of the other critical setup functions on the Analyzer with the exception of **QUICK TEST**.

Although **STRING CONFIGURATION** accesses **COMPANY / REGION**, **BATTERY TYPES**, **ALARM SETTINGS** and **TEST SETTINGS**, these **Templates** have already been covered in **Chapter 2** and will not be repeated in this section. **TEST SETTINGS** will, however, be covered in this section.

**Figure 2.1** shows the **TEST CONFIGURATION TEMPLATES** screen. When **STRING CONFIGURATION** is selected, the user is prompted through the three (3) screens shown in **Figure 2.8**, **2.9** and **2.10**.

Figure 2.8. Location selection screen.

Figure 2.9. String selection screen.

Figure 2.10. String configuration screen.

When using these three (3) String Configuration screens, the user may selection from a host of function keys (F1, F2, F3 and F4) to save, copy, edit, delete and enter additional information.

When the user is entering information in the **STRING CONFIGURATION** screen (Figure 2.10), there are three (3) Template entries that may be selected; otherwise data may be entered manually into these section. The three templates (**BATTERY TYPE**, **TEST SETTING** and **ALARM SETTING**) are detailed in the sections below.

Details on each of the **STRING CONFIGURATION** data entry fields are described below. Although many of these were previously covered in the **QUICK TEST** section, they are repeated here for clarity and comprehensiveness.

- (1) **STRING I.D.** – This is the name or Identification (I.D.) of the string.
- (2) **BASELINE STATUS** – This indicates to the user if the string that will be tested has been baselined. If YES is displayed, this indicates that the string has baseline values for each battery or cell. Baselining is covered in detail in a later section of this Users Manual.
- (3) **NUMBER OF BATTERY (S)** – This indicates the number of batteries or cells that will be tested in the string.

- (4) **BATTERY TYPE** – This screen lets the user enter the **BATTERY DETAILS** for the battery that is being tested. The user can either manually enter the information listed below, create a Template, or select from an existing template.
- **MANUFACTURER:** Battery/Cell Manufacturer.
  - **MODEL:** This is the Model number of the Battery/Cell being tested.
  - **TYPE:** This is a predefined selection menu. The user selects from the following types using the RIGHT and LEFT navigation buttons:
    - ⇒ **Other**
    - ⇒ **Lead Acid (AGM):** *Absorbed Glass Mat*
    - ⇒ **Lead Acid (Gel)**
    - ⇒ **Lead Acid (Flooded)**
    - ⇒ **Li-Ion:** *Lithium Ion*
    - ⇒ **NiCd:** Nickel Cadmium
    - ⇒ **NiMH:** Nickel Metal Hydride
  - **CAPACITY:** Entry of the Capacity of the Battery/Cell being tested. The value is entered at the C/10 (Capacity at a 10-Hour discharge rate) in Amp Hours.
  - **TEST LEVEL:** This is a predefined selection menu indicating if the user is testing a Battery or Cell. The user selects from the following test levels using the RIGHT and LEFT navigation buttons:
    - ⇒ Battery: Multi-Cell unit.
    - ⇒ Cell: Single unit.
  - **# CELLS(S) PER BATTERY:** Entry of the number of Cells in the Battery being tested. If a single cell is being tested, this value will be one (1), otherwise the user can manually enter a value from 1 to 31 or use the **RIGHT** and **LEFT** navigation buttons to increment or decrement the numeric value.
- (5) **TEST SETTINGS** – This screen lets the user enter the **TEST SETTINGS** for the string that is being tested. The user can either manually enter the information listed below, create a Template, or select from an existing template.
- **NOISE FILTERING** – This is a predefined selection menu for selecting the level of Noise Filtering used during testing. The user selects from the following predefined settings using the RIGHT and LEFT navigation buttons. Test time may vary depending on the level of noise filtering that is selected.
    - ⇒ **Off:** No noise filtering.
    - ⇒ **Low**
    - ⇒ **Medium**
    - ⇒ **High**
    - ⇒ **Auto:** The Analyzer will automatically determine the filtering level based on feedback from testing conditions.

- **POLARITY CORRECTION** – This is a predefined selection menu for selecting if the Analyzer will operate with correction ON or OFF. The user selects from the predefined settings using the RIGHT and LEFT navigation buttons. When ON, POLARITY CORRECTION automatically stores the absolute value of the voltage of the battery or cell being tested. This allows the user to rapidly test batteries or cells without worrying about the polarity.

This features should typically be turned OFF if the user is commissioning a new string and wants to know if any of the batteries or cells were installed in a reversed order.

⇒ On

⇒ Off

- **STRAP TEST START** – The user selects from the predefined settings (**MANUAL** or **AUTO**) using the **RIGHT** and **LEFT** navigation buttons. When **MANUAL** is selected, the test will automatically start once a Valid strap is detected. The delay time between the detection of the valid DUT and the start of the test is defined by the **AUTO-START DELAY (SEC)** setting (described below).
- **BATTERY TEST START** – The user selects from the predefined settings (**MANUAL** or **AUTO**) using the **RIGHT** and **LEFT** navigation buttons. When **MANUAL** is selected, the test will automatically start once a Valid battery or cell is detected. The delay time between the detection of the valid DUT and the start of the test is defined by the **AUTO-START DELAY (SEC)** setting (described below).
- **AUTO-START DELAY (SEC)** – The user must manually enter a value from 1 to 31 or use the RIGHT and LEFT navigation buttons to increment or decrement the numeric value. This is the amount of time the user will wait once a Valid DUT is detected.

(6) **ALARM SETTING**: This screen lets the user enter the **ALARM SETTINGS** for the testing. The following data entry is required for this screen:

**IMPEDANCE ALARMS**: Alarms for single-point impedance testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

- **IMPEDANCE HIGH (%)**: This is the impedance alarm above (greater than) the baseline value. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.

⇒ **Warning Value**: This is the warning value as specified as a percentage measured from the baseline value.

⇒ **Warning ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

⇒ **Fail Value**: This is the fail value as specified as a percentage measured from the baseline value.

⇒ **Fail ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

**IMPEDANCE LOW (%)**: This is the impedance alarm below (less than) the baseline value. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.

⇒ **Warning Value**: This is the warning value as specified as a percentage measured from the baseline value.

⇒ **Warning ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

⇒ **Fail Value**: This is the fail value as specified as a percentage measured from the baseline value.

⇒ **Fail ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

**VOLTAGE ALARMS:** Alarms for voltage testing results. The following sub-alarms fall under this section. Default values are shown on the Analyzer when entering this screen.

- **VOLTAGE HIGH (V):** This is the voltage alarm above (greater than) the pre-entered reference value. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.

- ⇒ **Warning Value:** This is the warning value as specified as a discrete value.

- ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- ⇒ **Fail Value:** This is the fail value as specified as a discrete value.

- ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**VOLTAGE LOW (V):** This is the voltage alarm below (less than) the pre-entered reference value. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section

- ⇒ **Warning Value:** This is the warning value as specified as a discrete value.

- ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- ⇒ **Fail Value:** This is the fail value as specified as a discrete value.

- ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

**CELSCAN ALARMS:** Alarms for CELScan testing results - Sulfation and Dryout. Default values are shown on the Analyzer when entering this screen.

- **SULFATION (%):** These values represent the percentage (%) of capacity loss due to battery/cell sulfation. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell, due to battery/cell sulfation, the alarm would be reached. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.

- ⇒ **Warning Value:** This is the warning value as specified as a percentage.

- ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- ⇒ **Fail Value:** This is the fail value as specified as a percentage.

- ⇒ **Fail ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- **DRYOUT (%):** These values represent the percentage (%) of capacity loss due to battery/cell dryout. For example, if a value of 10 was entered, this would mean that after 10% of capacity loss in the battery or cell due to battery/cell dryout, the alarm would be reached. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. Default values are set on the Analyzer when entering this section.

- ⇒ **Warning Value:** This is the warning value as specified as a percentage.

- ⇒ **Warning ON/OFF:** Allows the user to turn this alarm ON or OFF independent of the other alarms.

- ⇒ **Fail Value:** This is the fail value as specified as a percentage.



⇒ **Fail ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

**STRAP ALARMS**: These are alarms for strap testing results. Default values are shown on the Analyzer when entering this screen.

⇒ **Warning Value**: This is the warning value as specified as a percentage above the baseline value.

⇒ **Warning ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

⇒ **Fail Value**: This is the fail value as specified as a percentage above the baseline value.

⇒ **Fail ON/OFF**: Allows the user to turn this alarm ON or OFF independent of the other alarms.

- (7) **TEST VOLTAGE**: The user selects if the Analyzer will test the voltage of the DUT being testing. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.
- (8) **TEST IMPEDANCE**: The user selects if the Analyzer will test the single-point impedance value of the DUT being testing. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.
- (9) **TEST SULFATION**: The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery sulfation. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO. This function is only active on EC2000™ Analyzers.
- (10) **TEST DRYOUT**: The user selects if the Analyzer will run the CELScan™ algorithm for determining the amount of capacity loss due to battery dryout. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO. This function is only active on EC2000™ Analyzers and only for Valve Regulated Lead-Acid Batteries/Cells (Lead Acid – AGM and Lead Acid – Gel).
- (11) **# STRAP(S) PER BATTERY**: Entry of the number of Straps per Battery or Cell in the String being tested. The user can manually enter a value from 1 to 59 or use the **RIGHT** and **LEFT** navigation buttons to increment or decrement the numeric value.
- (12) **FLOAT CHARGE**: The user selects if the Batteries or Cells in the Sting being tested are on float charge or not. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.
- (13) **VOLT. REF. (CELL)(V)**: The user enters the Voltage Reference Value for the Cell. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for **VOLT. REF. (BATTERY) (V)** is automatically calculated. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.
- (14) **VOLT. REF. (BATTERY)(V)**: The user enters the Voltage Reference Value for the Battery. This value will be used for all of the Voltage Alarm calculations. When data entry is completed, the value for **VOLT. REF. (CELL) (V)** is automatically calculated. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.

*Note: Either CELL or BATTERY reference values may be enter first and the other is automatically calculated.*

- (15) **USE AUTO-CALC BASELINE**: The user selects if the Analyzer will automatically calculate a baseline for the string being tested or if manually entered values will be used. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.

If the user selects YES, then **BASELINE IMP. REF. (mΩ)**, **BASELINE ACF** and **BASELINE TEMP.(°C)** are not selectable for data entry.

Details on the methods and technology of the Automatic Baseline Feature on the Analyzer can be found in **Chapter 5**.

- (16) **BASLINE IMP. REF. (mΩ)**: The user enters the Baseline Impedance Reference Value for the Battery or Cell being tested. This value is used for calculating the alarm values. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section
- (17) **BASLINE ACF**: The user enters the Baseline ACF (Algorithm Calibration Factor) used with the CELScan Algorithms – Sulfation and Dryout). This value will be used for Sulfation and Dryout algorithm calibrations and adjustments. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.

When the **Auto Calculated Baseline** is not used, this value is typically calculated using the **BASLINE UTILITY** in the **UTILITIES → TOOLS Menu**. Details on the ACF and proper ACF generation procedure, please reference **Chapters 6 and 7**.

- (18) **BASLINE TEMP.(°C)**: The user enters the Baseline Temperature. This is the temperature at which the Baseline data was collected and is used in subsequent Sulfation and Dryout algorithm calibrations and adjustments. Values are entered manually or with the **RIGHT** and **LEFT** navigation buttons. There are no preset values on the Analyzer when entering this section.
- (19) **USE AUTO-CALC STRAP REFERENCE**: The user selects if the Analyzer will automatically calculate a reference value for the straps being tests. The **RIGHT** and **LEFT** navigation arrows are used for selecting between YES or NO.

When NO is selected, a **STRAP REFERENCE (mΩ)** field will appear and a value must be entered.

## BATTERY TYPE TEMPLATES

When using the **BATTERY TYPE TEMPALTE**, the user will the following two (2) screens. When selecting a <NEW> template, the user is prompted to enter the information shown in . At any time, the user may enter an existing template and edit, copy or delete information related to the template. Explanations of each entry field have previously been described.

MEMORY: 01 JAN 2010 13:00

### BATTERY TYPE TEMPLATES

<NEW>  
ABSOLUTE 1-100G39  
UNIGY U1HR1500  
SONNENSCHN A512/40G6

RETURN COPY DELETE

Figure 2.11. Battery Type Template.

MEMORY: 01 JAN 2010 13:00

### BATTERY DETAILS

SETTING NAME	VALUE
TEMPLATE NAME:	EAST PENN 1
MANUFACTURER:	EAST PENN
MODEL:	U1HR1500
TYPE:	VRLA(AGM)
CAPACITY (C/10)Ah :	56.8
TEST LEVEL:	BATTERY
# CELL(S) PER BATTERY:	1

RETURN SAVE COPY DELETE

Figure 2.12. Battery Details Template.

TEST SETTING TEMPLATES

When using the **TEST SETTING TEMPALTE**, the user will the following two (2) screens. When selecting a <NEW> template, the user is prompted to enter the information shown in . At any time, the user may enter an existing template and edit, copy or delete information related to the template. Explanations of each entry field have previously been described.

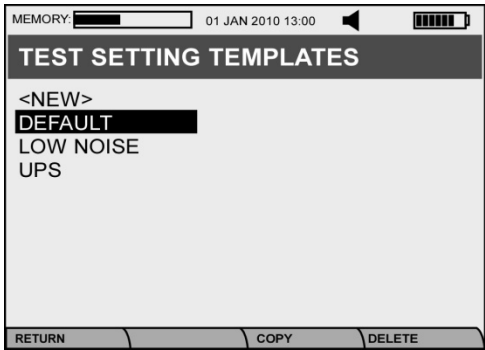


Figure 2.13. Test Setting Template screen.

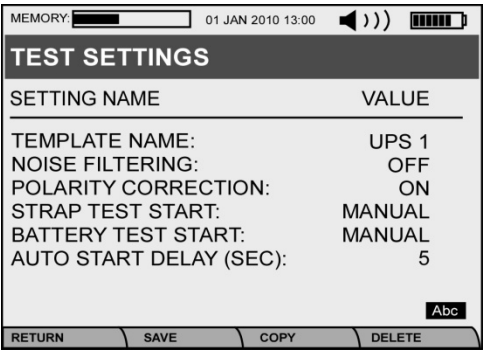
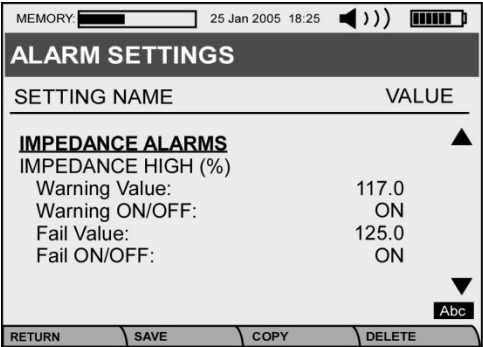


Figure 2.14. Test Settings screen.

ALARM SETTING TEMPLATES

When using the **ALARM SETTING TEMPALTE**, the user will the following two (2) screens. When selecting a <NEW> template, the user is prompted to enter the information shown in . At any time, the user may enter an existing template and edit, copy or delete information related to the template. Explanations of each entry field have previously been described.



<b>IMPEDANCE ALARMS</b>	
IMPEDANCE HIGH (%)	
Warning Value:	117.0
Warning ON/OFF:	ON
Fail Value:	125.0
Fail ON/OFF:	ON
<b>VOLTAGE ALARMS</b>	
VOLTAGE HIGH (V)	
Warning Value:	2.30
Warning ON/OFF:	ON
Fail Value:	2.35
Fail ON/OFF:	ON
VOLTAGE LOW (V)	
Warning Value:	2.20
Warning ON/OFF:	ON
Fail Value:	2.15
Fail ON/OFF:	ON
<b>CELSCAN ALARMS</b>	
SULFATION (%)	
Warning Value:	15
Warning ON/OFF:	ON
Fail Value:	20
Fail ON/OFF:	ON
DRYOUT (%)	
Warning Value:	15
Warning ON/OFF:	ON
Fail Value:	20
Fail ON/OFF:	ON
<b>STRAP ALARMS</b>	
STRAP (%)	
Warning Value:	150.0
Warning ON/OFF:	OFF
Fail Value:	200.0
Fail ON/OFF:	OFF

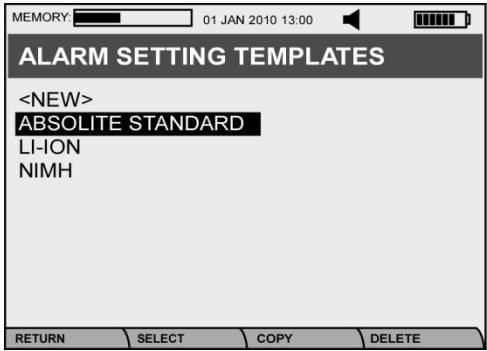


Figure 2.15. Alarm Setting Template screen.

Figure 2.16. Alarm Settings screen.

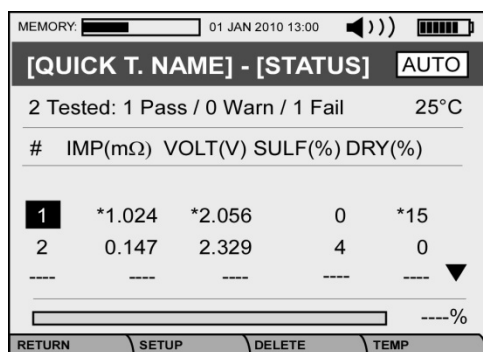
## **TESTING**

Now that the user is familiar with configuring the Analyzer, these configurations can now be used for testing. The following section covers how to use either Analyzer or IBMS™ configurations to perform testing.

### **TESTING USING THE ANALYZER**

Configurations may be used that were directly done on the Analyzer. This includes both **QUICK TESTS** and **STRING TESTING**. These configurations were previously covered in prior sections. This section covers the use of these configurations.

**QUICK TESTS** – This section covers testing using **QUICK TEST**.



**Figure 2.17.** Quick Test testing screen.

The screen shown in **Figure 2.17** shows the full test mode for **QUICK TEST**. All alarms and setting for **QUICK TEST** testing come from the **QUICK TEST SETTINGS** that were previously discussed in the **TEST CONFIGURATIONS** section of this **Chapter**. Details on each mode are listed below:

- (1) **IMPEDANCE METER** – This is a preset template on the Analyzer and allows the user to test impedance only.
- (2) **VOLTAGE & IMPEDANCE METER** – This is a preset template on the Analyzer and allows the user to test impedance and voltage only.
- (3) **VOLTAGE METER** – This is a preset template on the Analyzer and allows the user to test voltage only.
- (4) **CUSTOM TEMPLATE 1** – This is a user-entered template that allows for setup of CELScan™ (Sulfation and Dryout) in addition to impedance and voltage measurement.

**Note:**

- (1) When the user presses the **RETURN** key and exits **QUICK TEST** mode, no data is stored in memory.
- (2) When a single asterisk (\*) is shown next to the test result, this indicates a **WARNING** Alarm condition.

(3) When a double asterisk (\*\*) is shown next to the test result, this indicates a **FAIL** Alarm condition.

**STRING TESTING** – This section covers testing using the **TEST STRING** function.

When the user selects **TEST STRING** from the **MAIN MENU**, the following screens are displayed. These are presented below.

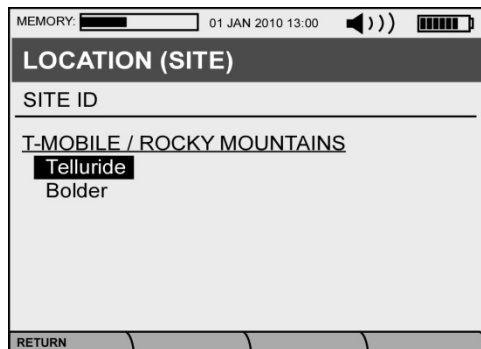


Figure 2.18. Test String testing screen.

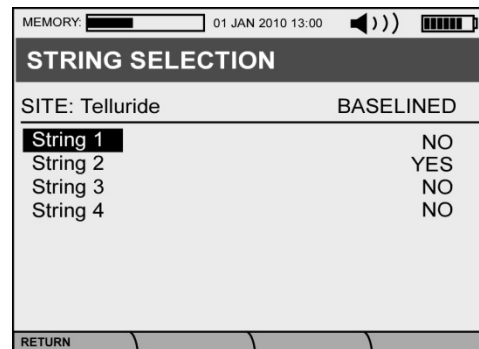


Figure 2.19. String Selection screen.

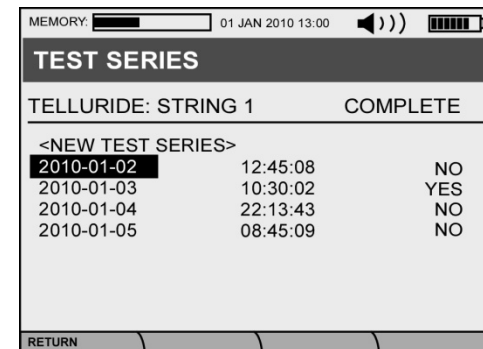


Figure 2.20. Test Series screen.

**Figure 2.18** is the first screen that the user sees. This screen allows the user to select the Site that will be tested. Upon selection of the site, the user is prompted to select from a list of string names as displayed in **Figure 2.19**. The baseline status is displayed for each string on the far right-hand side of the screen. A string that has been baselined (YES), cannot be retested.

Once a string is selected, the user is prompted to select a Test Series. A baselined (Completed – YES) string cannot be tested because the after baselining is completed, the string is permanently locked for testing.

A <NEW TEST SERIES> may be selected at any time. The screen shown in **Figure 2.21** is displayed when a New Test Series is selected or whenever an unbaselined string is selected for testing. The Test Temperature is a required entry field for this screen. Once a valid temperature is entered, the Start (F2) button may be pressed to begin testing.

The user may start testing when arriving at the screen shown in **Figure 2.22**. The user can scroll UP and DOWN and select the DUT to test. Testing begins by pressing the **ENTER** button. Test results are displayed on the far right as PASS, WARN or FAIL. These values are determined by pre-entered baseline and/or alarm values. Setup of these values can be found in a previous section of this manual. When the user scrolls UP and DOWN, test values are displayed for Impedance (Imp - mΩ), Voltage (VOLT(V)), Sulfation (SULF(%)) and Dryout (DRY(%)). Often, no values (---) are displayed under these headings. This indicates that no values were taken or reported.

Function keys may become active at different times during testing as required. When **Pending** is displayed, this indicates that the alarm condition has not yet been calculated via the automatic baseline calculator. The user must wait until a valid baseline is reached. Often F2 (Base-Line) is shown and the user may select to manually calculate a baseline value for the string using this function (**Figure 2.23**). The **Apply** button may be used to apply the newly calculated baseline

value. Otherwise, the user may select F1 and return to the previous screen without saving (updating) the baseline. For a complete explanation of the **Auto Baseline** function as well as **Impedance** and **ACF** (Algorithm Calibration Factor) functions, please reference **Chapter 5**.

The F3 (Temps) button shown in **Figure 2.22** may be used to manually enter individual Battery or Cell temperature. This temperature value is used for adjustments of the Battery or Cell impedance or CELScan™ values (Sulfation and Dryout).

TEST SETTINGS	VALUE
TEST TEMPERATURE (°C):	----
SITE:	BOULDER
STRING ID:	STRING 1/4
TEST START DATE:	2011/11/15
TEST END DATE:	
<hr/>	
BASELINE STATUS:	NO

**Figure 2.21.** Start Testing screen.

IMP(mΩ)	VOLT(V)	SULF(%)	DRY(%)
----	----	----	----
<hr/>			
STRAP 0:1-1		WARN	
STRAP 0:1-2		PASS	
BATTERY 1 / CELL 1:		PASS	
BATTERY 1 / CELL 2:		----	

65%

**Figure 2.22.** Testing screen

IMPEDANCE (mΩ):	8.227
ACF:	1.277

PLEASE WAIT.  
BASELINE CALCULATION IN PROGRESS.

24%

**Figure 2.23.** Auto Calculated Baseline screen.

The **EXIT TESTING** screen (**Figure 2.24**) is shown whenever all of the DUTS have been tested and the user selects (via pressing F1) to **RETURN**. While in this screen, the user can **CONFIRM** (F1), **RETURN** (F2) or select **TEMPS** (F3). When **CONFIRM** is selected, this strings test sequence can no longer be opened for future testing. It is permanently locked and can only be reviewed, deleted or transferred to IBMS.

## CHAPTER 3 – REVIEWING THE TEST RESULTS

### ***About this Chapter***

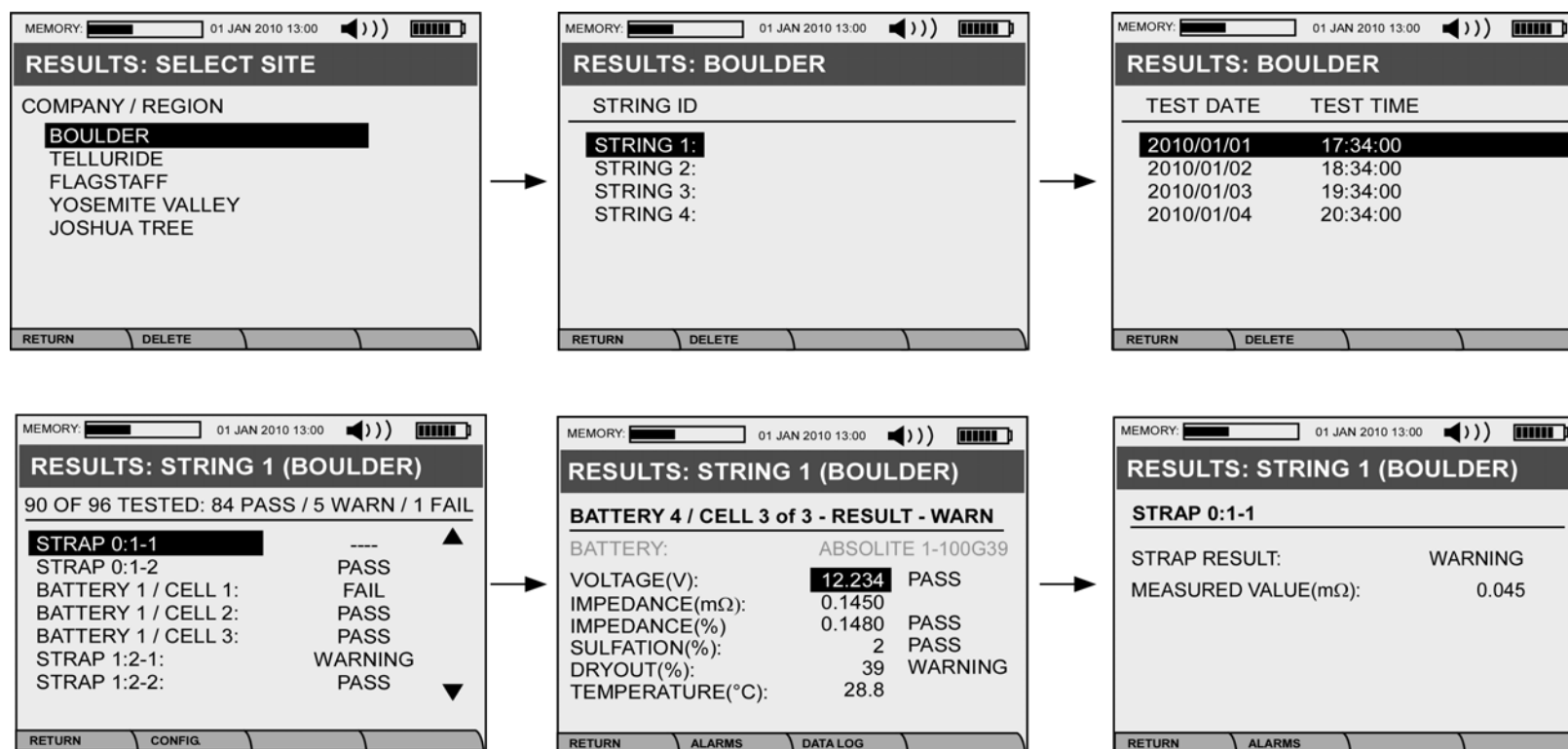
This Chapter shows the user how to review the test results and test settings / configurations that were used during testing.

After testing is completed or during testing (before or after a test sequence is locked), the user may navigate to the **TEST RESULTS** screen to review test results in detail. The following functions may be accomplished in the **TEST RESULTS** section:

- (1) Test results may be deleted.
- (2) Limited battery and site-specific information may be entered and/or modified.
- (3) Test Configurations and the settings associated with them may be viewed.

The following six (6) screens shown in **Figure 3.1**, illustrate the navigation for reviewing test data.





**Figure 3.1.** Various user screens for navigating **TEST RESULTS** Menu.

At most points, data may be deleted. The user is always prompted with a **WARNING** screen to ensure that the deletion of data was intended.

Pay close attention to the Function Buttons (**F1**, **F2**, **F3** and **F4**) at the bottom of the screens. These functions allow the user to view various setup parameters that were used for testing. Additionally, some data entry options are available to the user at various points during navigation.

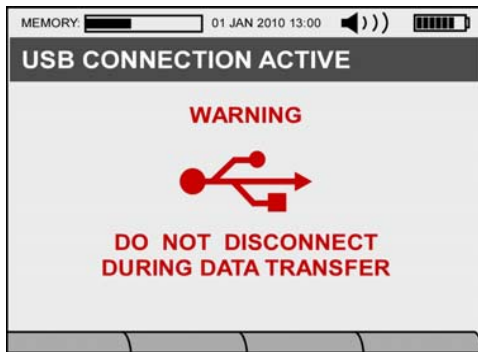
## CHAPTER 4 – CONNECTING THE ANALYZER TO IBSM™ SOFTWARE

### **About this Chapter**

This Chapter describes how you connect the Analyzer to IBMS™ (Intelligent Battery Management System™) Software. Once connection is accomplished, please reference the IBMS Users Manual for details on how to transfer and analyze your data using IBMS™.

The user must first connect the Mini-USB cable from the Analyzer to a PC where IBMS™ is installed and running.

Now navigate to the **CONNECT TO PC** from the **MAIN MENU** (Figure 1.5). After several seconds, you should see the screens shown in **Figure 4.1** below.



**Figure 4.1.** USB Connection screen.

The Analyzer is now connected to the PC and is ready to communicate.

## CHAPTER 5 – ADVANCED ANALYZER FEATURES & FUNTIONS

### About this Chapter

This Chapter covers all the Advanced Features and Functions of the EC-Series Analyzers (EC1000™ and EC2000™). There is also reference to IBMS™ (Intelligent Battery Management System) Software in this Chapter since there is a great deal of overlap between the two systems.

This Chapter also covers a number of the functions in the **TOOLS** menu under **UTILITIES**.

### TOOLS

#### **BASELINING – ANALYZER (BASELINE UTILITY)**

This section covers both the **Baseline Utility** in the **Tools Menu** as well as Autobaselining and the theory and principles behind baselining on the Analyzer. Since IBMS™ Software (Advanced User Setting) may be used to adjust baseline values, this concept is covered briefly in this section.

- (1) **AUTOBASELINE** – The baseline and **Algorithm Calibration Factor (ACF)** are derived values that are used to accurately calculate (adjust / compensate) the level of battery sulfation and dryout as well as impedance reference values.

The Autobaseline feature on the Analyzer is used to automatically calculate a valid baseline value (ACF and Impedance) for the string of batteries or cells being tested. Each battery or cell carries its own baseline value in addition to a string-level baseline value. When the user selects YES for "**USE AUTO-CALC BASELINE**" in the String Configuration setup, the Analyzer will automatically arrive at a baseline value for the string of batteries or cells during normal testing. **Figure 2.10** shows where the user selects this information.

Autobaseline (YES) is the default option on the Analyzer. It is recommended to keep this feature enabled unless you have suitable, prior knowledge of the battery or cell to be tested, in which case the following BASELINE values may be manually entered.

- BASELINE IMP. REF. (mΩ)
- BASELINE ACF
- BASELINE TEMP. (°C or F)

*Note:*

- *Entering values manually is an advanced user function and should be done by trained / experienced users.*
- *Baseline Temperature must be entered correctly or results may be calculated incorrectly on the Analyzer.*

- (2) **IBMS™ BASELINE ADJUSTMENT** – IBMS™ may be used to adjust baseline values that have been acquired / determined by the Analyzer. This function is important because, the user may want to manually adjust (override) the baseline value if the auto-calculated value is determined to be less accurate than one determined by the user. When the "Adjust Baseline" Advanced User function is used, the new baseline value must be loaded back to the Analyzer for subsequent testing. **Figure 5.1a** shows the IBMS™ screen where the baseline may be adjusted. You must be running IBMS™ Version 2.1.0 (Build 40) or later to use this Advanced function.



Figure 5.1b. IBMS™ baseline adjustment feature.

- **Relative Degradation** – Relative Degradation is Global Energy Innovations’ universal parameter to follow the evolution of battery health based on its Chemical Properties (e.g. CELScan™). Relative Degradation is set such that a 100% level corresponds to a healthy battery. As the battery ages, the Relative Degradation levels are expected to increase. Levels below 100% often indicate battery conditions such as internal short-circuit formation. For any lead acid battery types (AGM, Gel and Flooded), Relative Degradation readings can only be viewed when the Advanced User Setting is active and only in the “Adjust Baseline” tab as shown in **Figure 5.1b**. For non-lead acid battery type (Such as Li-Ion, NiMH and others), Relative Degradation can be used as an indicator of the evolution of the battery chemical properties, allowing the user to pinpoint defective batteries within a string.

- **Baseline Adjustment** – The Baseline cannot be adjusted on the Analyzer during use in the field. Baselines, however, may be adjusted using IBMS™ when the user is in the Advanced User Mode (Configuration → Options → Test View Results). The “Adjust Baseline” tab (See **Figure 5.1b**) must first be selected. This advanced tool is NOT intended to be used to make a string of batteries look healthy by adjusting the Algorithm Calibration Factor (ACF) to a frivolous value, however, its intended use is to increase the accuracy level of baseline determination of the string. Hence, the utility should only be used by expert users who intimately understand the consequences of changing the baseline values. Additionally, Baseline Adjustment should only be done once or twice for any strings. In particular, the purpose of Adjust Baseline is to allow the user to adjust ACF and CELScan™ readings when an error was made such as:
  1. The Baseline Values were manually entered and, after testing, appear to be incorrect.
  2. An Auto Baseline value was determined by the Analyzer that appears to be inaccurate or faulty.

The new ACF value saved from the Adjust Baseline should be used for all future tests on the string (e.g. changes of the baseline value in the Test Configuration). It is the responsibility of the User to ensure that the Configuration is loaded back to the Analyzer for future testing of the same string.

The Adjust Baseline Screen presents several graphs depending of the battery type selected in the string:

1. **Relative Degradation (Population Referenced) Adjustment Utility:** This graph is used to select the level of Relative Degradation that should correspond to 100%, based on the collected dataset (e.g. using the original ACF).
2. **Relative Degradation (Population Referenced) Updated Values:** The changes made on the Adjustment Graph are immediately reflected in this graph to the user. Based on this graph, the user can decide if the new baseline is adequate or not.
3. **Sulfation (%) Updated Values:** The changes made on the adjustment graph will be immediately reflected on the Sulfation level to the user. Based on this graph, the user can decide if the new baseline is adequate or not. This graph is only displayed for Lead Acid Battery Strings.
4. **Dryout (%) Updated Values:** The changes made on the adjustment graph are immediately reflected on the Dryout level to the user. Based on this graph, the user can decide if the selected baseline is adequate or not. This graph is only displayed for Lead Acid Battery Strings consisting of AGM or Gel type batteries..

There are three methods for performing an ACF adjustment with the Relative Degradation (Population Referenced) Adjustment Utility Graph:

1. **Input an ACF value in the Updated ACF box at the left of the graph:** Changes will cause automatic updating of the other graphs as well as movement of the blue line in the Adjustment Utility Graph according to the new ACF value. The percentage number next to the box indicates what current Relative Degradation level is considered to be 100% after accepting the change.
2. **Select a Relative Degradation Levels in the Adjustment Utility Graph:** The ACF value in the Updated ACF box, percentage value and the blue line in the graph will be automatically changed to reflect the selection. The other graph will be updated as well to reflect the new ACF value.

3. **Drag the blue line in the Adjustment Utility Graph:** By dragging the blue line up or down, the Updated ACF box Value, percentage will be updated accordingly. The other graphs will be updated as well to reflect the new ACF value.

After selection of a new ACF, the user can immediately see the effect of this new baseline on the CELScan™ levels. Based on the CELScan™ updated graphs, the user can decide if the new baseline is adequate and by clicking “Save Changes” the new ACF value is saved into the Test Configuration. If the new ACF value does not seem adequate, the user can either click on the “Cancel Changes” button to reset the ACF value or continue adjusting the ACF appropriately.

The ideal ACF is one that removes outlier batteries having an excessively low Relative Degradation whilst not compromising the detection of batteries showing small levels of chemical degradation. Hence, the ideal ACF should be a batter with a low Relative Degradation without being out of family.

Finally, since the baseline values used at the time of the test are tracked in the Test Configuration tab, any erroneous ACF change can be corrected (returned) to the original value by reviewing the historical ACF value displayed in the Test Configuration screen.

- (3) **AUTO-CALCULATED-STRAP REFERENCE** – The integrity of the straps that connect the batteries or cells together is critical for good operation and health of the battery string. Similar to the **Autobaseline** feature, the Analyzer has an automated **Auto-Calc Strap Reference** function that is used for automatically calculating a valid Strap Impedance Reference value when a string is first tested.

The user may enable this feature by selecting YES to “**USE AUTO-CALC STRAP REFERENCE**” when configuring a string (String Configuration Screen).

- (4) **BASELINE UTILITY** – The **BASELINE UTILITY** is used to determine the reference values for Impedance and ACF as presented in **Figure 5.1b** below. The main purpose of this tool is to permit the user to determine the Impedance Reference (IMPEDANCE REF. (mΩ)) and ACF in a situation where the Autobaseline function (analysis) failed, was not reliable or in a situation where testing is being done in different locations on batteries with different state-of-health (For example, when the tested string consists of old/aged batteries without a baseline value/history, whilst new batteries of the same make and model are available elsewhere to test and acquire valid baseline data.).

Note: There is no baseline utility for strap impedance. If the user wants to determine the strap reference value without using the **Auto-Calc Strap Reference** feature, they can do it manually by performing a **QUICK TEST** (Impedance) on the strap.

When using the **BASELINE UTILITY**, the user must input the following information:

- a. Battery Type
- b. Capacity (Amp hours)
- c. Number of Cells per Post Pair
- d. Temperature – Battery of Cell

Upon completion of this data entry, the user starts the test by pressing the **F2** button (Start).

Note: There is no baseline utility for strap impedance. If the user wants to determine the strap reference value without using the **Auto-Calc Strap Reference** feature, they can do it manually by performing a **QUICK TEST** (Impedance) on the strap.

**Warning:** Since the Baseline Test is done on a single battery or cell, it is strongly recommended to use the **BASELINE UTILITY** only in particular circumstances where the Autobaseline function cannot be used.

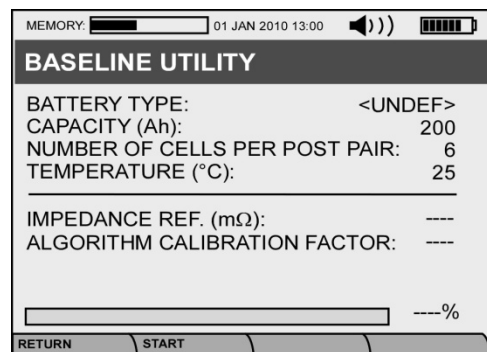


Figure 5.1b. Baseline Utility screen.

## **REPEATABILITY UTILITY**

The **REPEATABILITY UTILITY** tool allows the user to rapidly check how repeatable testing is on a battery, cell, strap or other electrical conductor (DUT – Device Under Test). Repeatability is affected by noise and other disturbances that may be present across the DUT. The Analyzer uses FFTs and other advanced signal processing techniques to reject noise, however, some noise will still cause reading inaccuracies and ultimately may lead to incorrect results.

Whenever the user suspects **HIGH NOISE** conditions such as around old UPS systems or whenever reading seem inaccurate or odd, using this tool will allow for rapid assessment of the condition.

The **REPEATABILITY UTILITY** tool (**Figure 5.2**) is fully automated and should be performed in the conditions representative of the normal test conditions. The simply connects the Analyzer to a DUT and presses the **F2** (Start) button. The Analyzer then performs a series (5) of measurements and reports the noise level and repeatability statistics (CV – Coefficient of Variation) measure for **IMPEDANCE, VOLTAGE** and **CHECMICAL PROPERTIES** (Sulfation and Dryout).

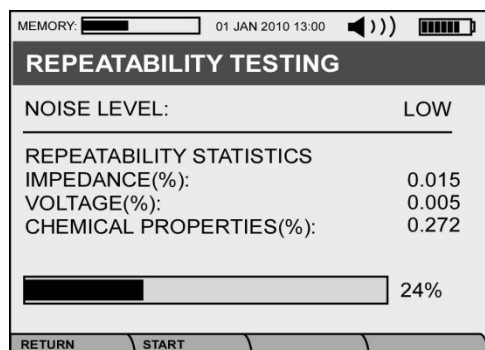
Based on the reported CV values, the Analyzer calculates a noise level of LOW or HIGH. When setting up the Analyzer for testing, the Noise Level may be set as shown in **Figures 2.3** and **2.9**.

- (1) **LOW** – The noise level is low enough that Noise Filtering should be turned off or set to **LOW**.
- (2) **HIGH** – The noise level is high and the Analyzer must be set to **HIGH** so that it may adequately reject noise. Often, in high noise conditions the Analyzer cannot take accurate readings.

(3) **AUTO** – This setting will automatically set the Analyzer to the best setting it can based on signal processing and data analysis.

Note: CV readings above 2-3 indicate that the analyzer may take inaccurate readings. Beware of data when repeatability statistics are above 3.

**Equation 5.1** is the calculation (CV) performed on the data from the five (5) repeatability tests where CV is the Coefficient of Variation,  $\sigma$  the standard deviation and  $\mu$  the mean.



**Figure 5.2.** Baseline Utility screen.

$$CV = \frac{\sigma}{|\mu|}$$

**Equation 5.1.** Coefficient of Variation definition.

## **BATTERY REPLACEMENT UTILITY**

The **BATTERY REPLACEMENT UTILITY** tools allows the user to replace batteries or cells in the sting, for whatever reason, without changing or editing the **String Configuration**. In most situations, the replacement is essential because the battery or cell is faulty, warned or has failed.

### ***ANALYZER OPERATION***

- (1) To access the **BATTERY REPLACEMENT UTILITY** screen, the user must first navigate through two (2) screens (**Figure 5.3** and **5.4**) to locate the batteries or cells to be replaced.
- (2) In the main **BATTERY REPLACEMENT UTILITY** screen (**Figure 5.5**), the user indicates the batteries to be replaced with the Function “Add” (F2). This screen will indicate “**Needs Testing**” for any batteries marked as replaced either from the Analyzer or from IBMS™ which have not yet been tested. The screen will also list the batteries that have been replaced and been baselined. In this case, only the ID of the battery is displayed without the “**Needs Testing**” message.



- (3) By using the Function “Dates” (F3), the user can enter manufacturing and installation dates of the batteries. Those entries are not necessary for the Analyzer operation but allow the user to keep track of the battery inventory.
- (4) Once the user indicates all of the batteries being replaced, the user can leave the Battery Replacement Utility Tool and proceed to a string test to collect the new baseline data.

*Note: These tests are required to update the individual battery or cell baseline values used in the **ADVANCED USER** mode in IBMS™, however, these values DO NOT change the general Reference Impedance and ACF values associated with the entire string.*

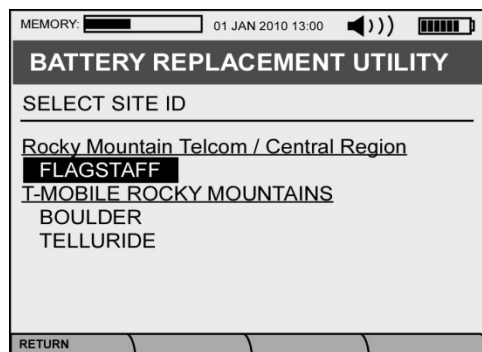


Figure 5.3. Battery Replacement Utility Screen 1.

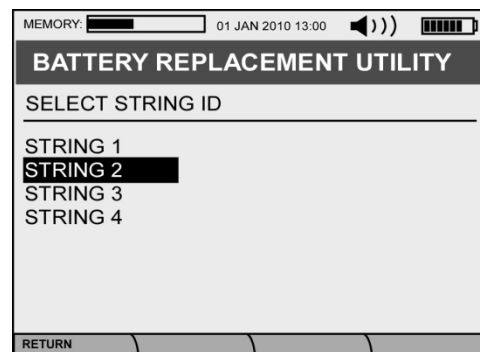


Figure 5.4. Battery Replacement Utility Screen 2.

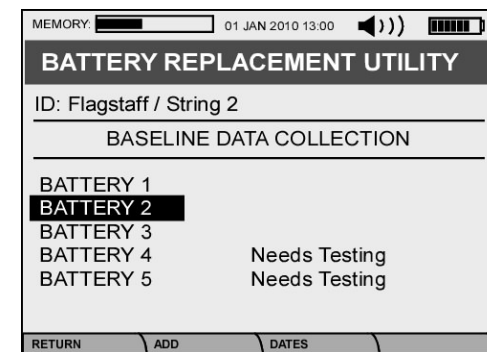
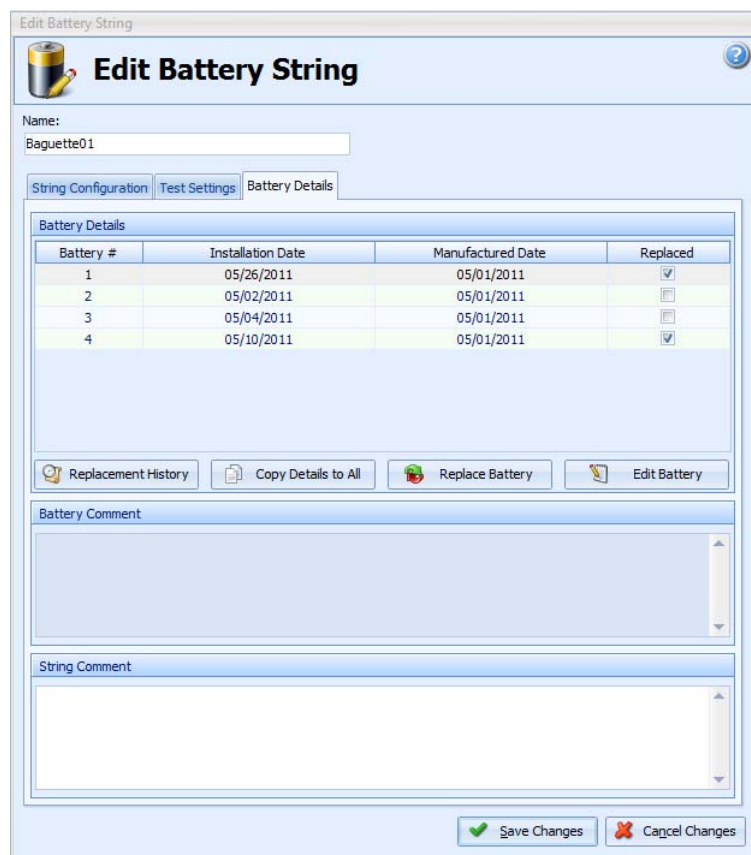


Figure 5.5. Main Battery Replacement Screen.

Global Energy Innovations, recommends testing batteries on float after an equilibration period of two week (no equalization during this period). If tests are performed at open circuit (batteries being top charged), allow 30 minutes after disconnecting the string from the charger before performing any Analyzer tests. The 30 minute period is necessary to insure that batteries have reached a quasi-equilibrium state.

Using IBMS™, the user may review battery details and schedule eventual battery replacement in the inventory management section. To schedule battery replacements, the user selects the string where batteries will be replaced using the **INVENTORY MANAGEMENT** window. This will cause a pop-up of the **EDIT BATTERY STRING** window and the batteries to be replaced can be flagged (Checked Replaced) in the **BATTERY DETAILS** tab (Figure 5.6).

To schedule a battery to be replaced, the user selects a battery and then clicks on the **REPLACE BATTERY** button. In the **REPLACEMENT BATTERY** window (Figure 5.7), the user can optionally enter the **Installation Date** and **Manufactured Date** of the replaced battery. By clicking on the **REPLACE BATTERY** button, the user will be asked to confirm the changes before they become definitive. The modified string must be updated to the Analyzer via IBMS™ for future field testing. When using the Analyzer, the batteries to be replaced will now show **NEEDS TESTING** in the **BATTERY REPLACEMENT UTILITY** screen. More details on the use of IBMS™ Battery Replacement functions can be found in the IBMS™ Users Manual.



**Figure 5.6.** Battery Details tab in the Edit Battery String screen of IBMS™ inventory Management.

**Figure 5.7.** Replace Battery screen.

## **AUTO CALIBRATION**

This function is used for performing a complete Analyzer Calibration. If the Analyzer FAILS the calibration, please contact support for assistance.

## **MASTER RESET**

This function is used for restoring the Analyzer to its factory settings. Please review the **WARNING** screen before confirming.

### **EJECT SD CARD**

This function is used to safely eject the Mini-SD card.

### **SYSTEM DIAGNOSTICS**

This screen is only meant to be used by Technical Support for troubleshooting the Analyzer.

### **TEMPERATURE MEASUREMENTS & CORRECTION**

Temperature values entered on the Analyzer are used for calculating and adjusting values of Impedance and the CELScan™ values (Sulfation and Dryout). Pay close attention to enter the correct temperature values to ensure accurate results. The three (3) places where temperature is most often entered are listed below:

- (1) Sting Configuration: BASELINE TEMPERATURE.
- (2) Start Testing Screen: TEST TEMPERATURE.
- (3) Testing Sequence: F3 (TEMPS) – Individual Battery or Cell Temperatures may be entered during testing.

The Analyzer ships with a precision Fluke® Model 62 Infrared Thermometer (P/N: 1010-0002) for accurately measuring battery temperature. Battery or Cell temperature is best taken by measuring the temperature of the Positive or Negative terminal. Please reference the Fluke Model 62 Infrared Thermometer data sheet on the Global Energy Innovations' website for details on using the thermometer (<http://www.globalei.com/bms/accessories-replacement-parts/infrared-thermometer.html>).

### **ANALYZER / IBMS INTERACTION**

The Analyzer has been designed to interact with IBMS to facilitate easy operation and configuration. Although the Analyzer may be used in a stand-alone fashion (Without IBMS), it is recommended that IBMS be used for configuration.

There are also a number of advanced functions that are only accessible via IBMS. Please reference the IBMS Users Manual and Quick Start Guides for details on this subject. Some of the critical features are as follows:

- (4) Update of firmware.
- (5) Addition of new features.
- (6) Synchronization of the Clock

Whenever connecting to IBMS, you must first navigate to the **CONNECT TO PC** at the **MAIN MENU** and select this function. This puts the Analyzer in its communication mode so that it is ready to communicate with a Personal Computer (IBMS) via the USB port.



## CHAPTER 6 – TROUBLESHOOTING

### About this Chapter

This Chapter covers troubleshooting for the Analyzer. The various sections covers various common problems that you might encounter and how to resolve these problems.

### FIRMWARE UPGRADES

When upgrading the firmware on the Analyzer, IBMS communicates to the Analyzer and through USB. Occasionally, the communication between Linux (Analyzer Operating System) and the PC (Windows) will encounter an error. If this occurs, the user will see the screen below (**Figure 6.1**). Simply follow the instructions on the screen and reload the firmware.

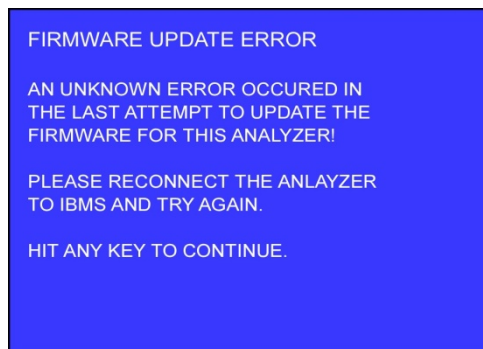


Figure 6.1. Firmware update error.

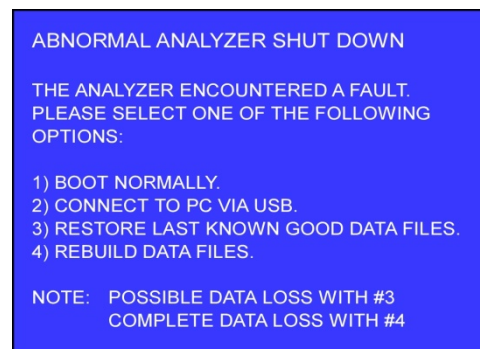


Figure 6.2. Analyzer (system) recovery screen.

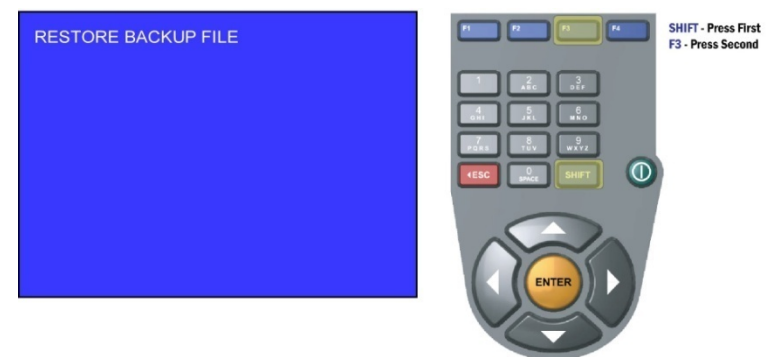


Figure 6.3. Analyzer restore screen.

### CRASH RECOVERY

If for any reason the Analyzer crashes, the user will likely see the screen shown in **Figure 6.2** when the Analyzer is rebooted. Follow the instructions on the screen to recover.

If the Analyzer boots but does not properly recover (i.e. The Analyzer continues to crash or exhibits abnormal behavior), the user may use the recovery key strokes shown in **Figure 6.3**. After pressing the Power ON button, press the SHIFT key first and then press the F1 key. Hold both keys down together and you will see the screen in **Figure 6.3**. The Analyzer will display **RESTORE BACKUP FILE** if the recovery process has successfully started. After booting, the Analyzer should operate normally.

## ANALYZER SPECIFICATIONS

### Performance Specifications and Operating Conditions

<b>Test Method</b>	CELScan™ Frequency Response Analysis. Completely non-intrusive.
<b>Data Trending</b>	Available but not required for measurement and detection of battery health degradation. (Battery health is determined from a single measurement).
<b>Amp-Hour Capacity Range for Batteries Under Test</b>	5 Ah to 2,000 Ah, Specified Performance Range 1 Ah to 9,999 Ah Operating Range  Amp-hour measurement capabilities depend upon whether or not the battery impedance is within the measurement range of the device. Typically, the larger a battery's Ah capacity, the lower its impedance.
Measures Battery on Float	Yes – (battery must be fully charged and at equilibrium)
Measures Batteries at Open-Circuit	Yes – (battery must be fully charged and at equilibrium)
<b>Impedance</b>	
Measurement Range	50 $\mu\Omega$ to 1 $\Omega$
Resolution	0.001 mOhms for all measurable impedance values
Accuracy	$\pm 1.0\%$ (for Impedance > 1 m $\Omega$ to 1 $\Omega$ ) $\pm 1.0\%$ (for Impedance > 100 $\mu\Omega$ to 1 m $\Omega$ )
Accuracy Traceability	Through NIST traceable standards
Repeatability	$\pm 1.0\%$ (for Impedance from 100 $\mu\Omega$ to 1 $\Omega$ )
<b>Voltage</b>	
Range	0 to 17 VDC
Resolution (Display)	10 mV
Accuracy	$\pm 0.5\%$
Accuracy Traceability	Through NIST traceable standards
Repeatability	$\pm 0.5\%$

<b>Sulfation</b>	
<b>Battery Charge Capacity Loss</b> (specified for Impedance range: 100 $\mu\Omega$ to 1 $\Omega$ )	
Range	0 to 100% (relative to the amount of battery charge capacity degradation due to Sulfation)
Accuracy	$\pm 2.5 \%$
Accuracy Traceability	Test methodology traceable to NIST standards
Repeatability	$\pm 1.0 \%$
<b>Dryout</b>	
<b>Battery Charge Capacity Loss</b> (specified for Impedance range: 100 $\mu\Omega$ to 1 $\Omega$ )	
Range	0 to 100% (relative to the amount of battery charge capacity degradation due to Dryout)
Accuracy	$\pm 2.5 \%$
Accuracy Traceability	Test methodology traceable to NIST standards
Repeatability	$\pm 1.0 \%$
<b>Cell Terminal Strap Impedance (mOhms)</b>	
Measurement Range	50 $\mu\Omega$ to 1 $\Omega$
Resolution	0.001 mOhms for all measurable impedance values
Accuracy	$\pm 1.0 \%$
Accuracy Traceability	Through NIST traceable standards
Repeatability	$\pm 1.0 \%$ (for Impedance from 100 $\mu\Omega$ to 1 $\Omega$ )
<b>Measurement</b>	
<b>Pass/Warning/Fail Indicators</b>	
Yes (visual and audio)	
<b>Specific Gravity</b>	
Manual Logging	
<b>Calibration</b>	
Automatic System Calibration upon Startup (System Boot)	
Yes - Standard	
Annual Instrument Calibration	
Auto calibration routines build-in. Annual Calibration (Certificate) may be performed if required.	
Automated Baseline Baseline Adjustment Utility	
Automated baseline generation and adjustment utility for rapidly determining your baseline Impedance, Sulfation and Dryout baseline values for new and old batteries or battery strings.	
<b>Upgradeable</b>	
Yes (Oscilloscope - Line Noise Detect, Voltmeter, Others as available)	

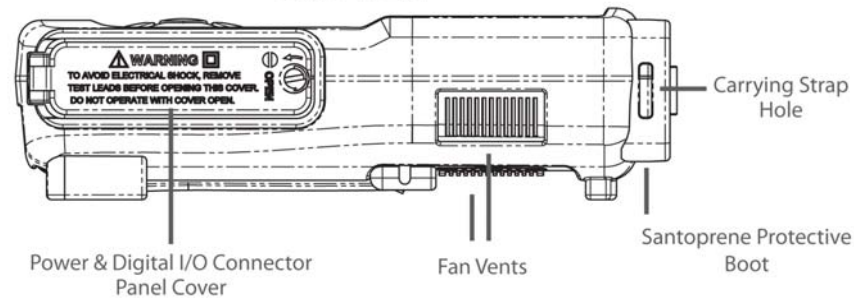
<b>Display</b>	
Type	Color - TFT LCD
Display Viewing Area	3.50 in (8.9 cm) Diagonal 70.08 (W) x 52.56 (H) mm
Display Format & Color Depth	320 (W) x 3 [R.G.B.] x 240 (H), 16M Colors
Backlight	LED Backlight / White LED
<b>Memory</b>	
Type	Read/Write Flash RAM (Mini SD)
Supported Size	16 GB
String/Cell Data Storage Capacity	Depends on SD Card Size and String Configuration
<b>Communications</b>	USB, Ethernet, Mini SD Card
<b>Internal Battery</b>	
Type	Lithium-Ion (Standard and High-Capacity Options)
Voltage	12 VDC
Capacity	Standard - 5.4 Ah, High-Capacity - 8.0 Ah
Typical Instrument Battery Run Time	Standard - 6 to 10 hrs , High-Capacity - 8 to 12 hrs (depending on use)
Charge Time	3.0 to 4.5 hrs (more for High-Capacity)
<b>AC Adapter Charger</b>	
Input Voltage	90-264 VAC
Output Voltage	15 VDC
Output Current	1.67 Amps
Frequency	47-63 Hz
<b>DC Vehicle Adapter Charger</b>	
Input Voltage	12.0 VDC
Input Current	8 Amp max
Output Voltage	115 VAC
Output Frequency	60 Hz
Output Power	60 Watts Continuous (75 Watts – 5 Min.)
<b>Environment Conditions</b>	
Operating Temp Range	0° to 45° C
Storage	-20° to 60° C
RH Non-Condensing	90%
<b>Key Pad</b>	Silicone Rubber
<b>Upload New Software from Internet or CD</b>	Yes – Using IBMS™ (Intelligent Battery Management System™) Interface and Reporting Software
<b>Data Collection and Reporting Software</b>	Yes – Using IBMS™ (Intelligent Battery Management System™) Interface and Reporting Software



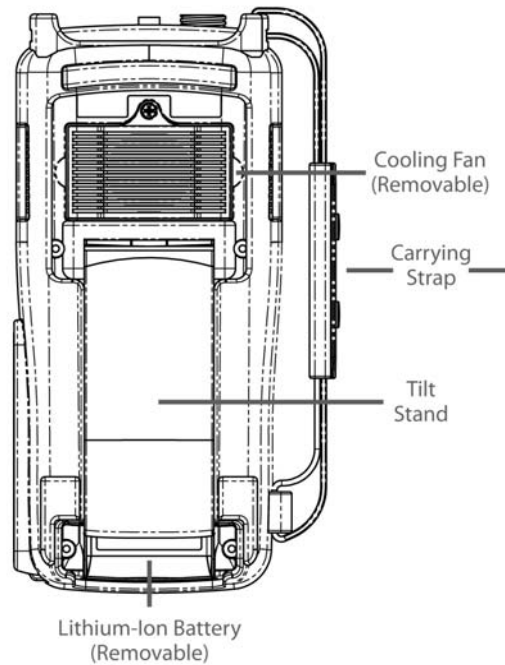
<b>User Programmable Functions</b>	
Number of preset battery/string configurations that can be stored	Depends on SD Card Size and String Configuration
Voltage Alarms	Yes
Impedance Alarms	Yes
Sulfation Capable (Capacity Loss Reading)	Yes
Dryout Capable (Capacity Loss Reading)	Yes
Manual Push Button Test Mode and Hands-Free, Auto-Start Test Mode	Yes
<b>Safety Features</b>	
Over-Voltage Auto-Reset Breaker (High-Voltage Protection)	Overvoltage Warning: 17 VDC Danger Warning: 50 VDC Damage Point (Protection Failure): 600 VDC max.
Reverse Polarity Protected	Yes
<b>Weight</b>	2.8 lb (1.27 kg)
<b>Dimensions</b>	4.25 x 10.05 x 2.30 in (108 x 267 x 58 mm)
<b>Warranty</b>	1-Year Limited Warranty
<b>Cable Connector Assemblies</b>	
Standard Kelvin Clips	Yes (with removable jaws)
Double-Point Kelvin Probes	Yes (with removable tips)
Single-Point Kelvin Probes	Yes (with removable tip)
<b>Optional Accessories</b>	
SD Card Reader	For use with PC
DC Vehicle Adapter Charger	For use with AC Adapter Charger
Premium Hard Carrying Case	Heavy-duty case for protection of handheld device
Accessory Cable Set	For use with Oscilloscope, Voltmeter, Other
<b>Service Support</b>	
Instrument Training	Yes
Customer Support Website	Yes
Technical Support Hotline	Yes
Warranty Extension Available (1 and 2 Year)	Yes
Instrument Calibration Program	Yes

**EC1000™ & EC2000™ PRODUCT IMAGES (PART I)**

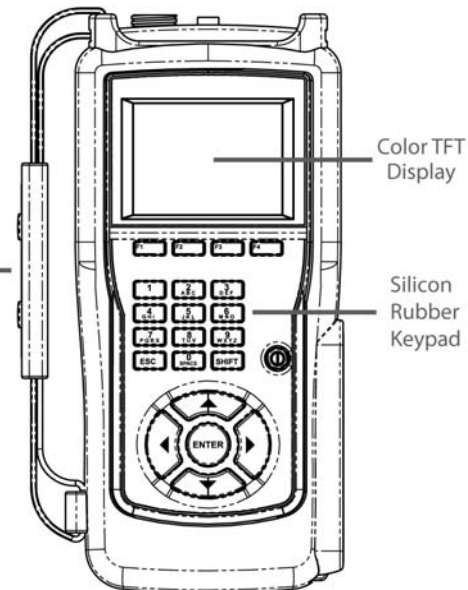
**SIDE VIEW**



**BACK VIEW**



**FRONT VIEW**



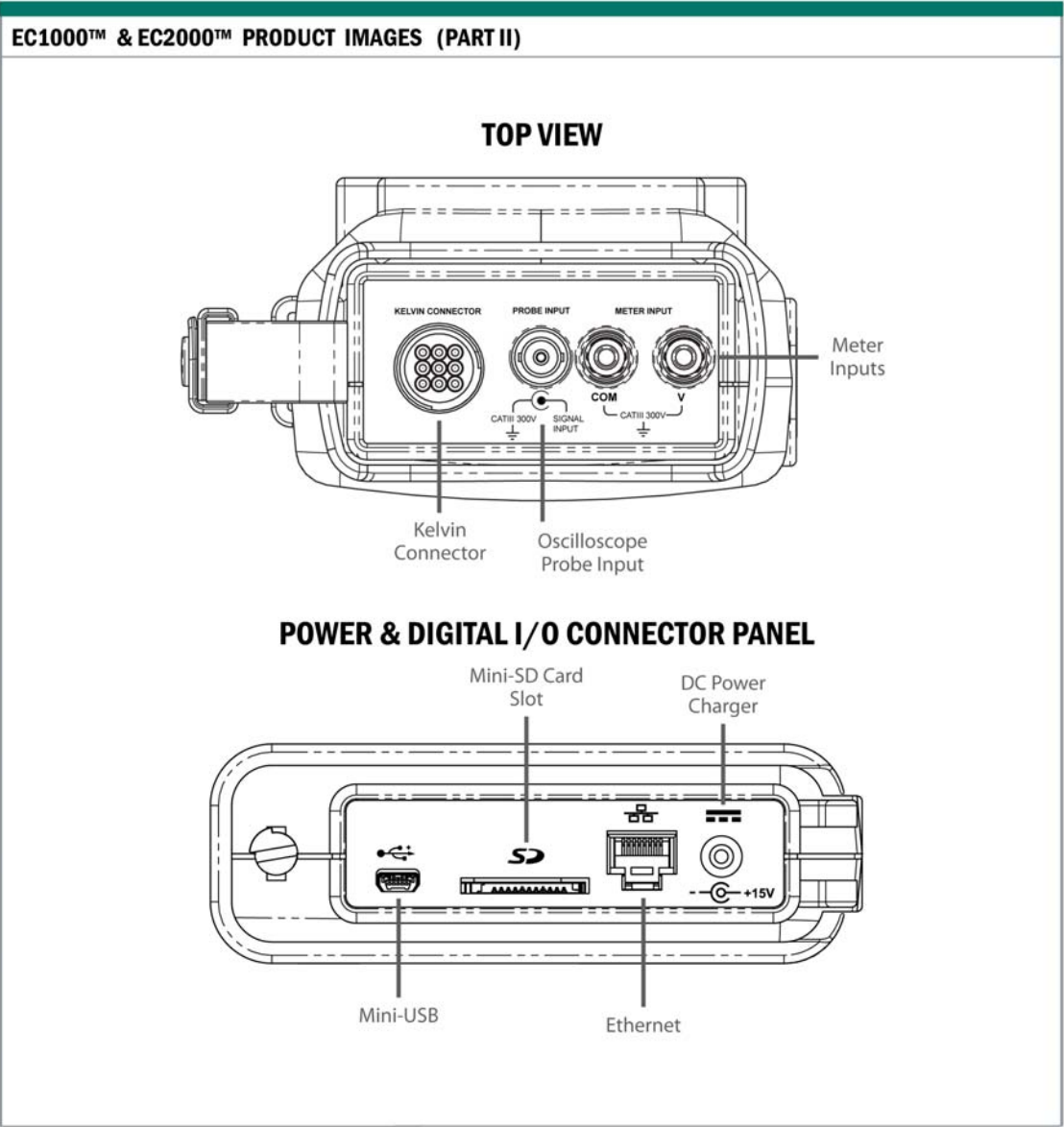


Table AS-01. Analyzer technical specification and product images

## INDEX

### A

Absorbed Glass Mat.....	27, 34
AC / DC Current Clamp.....	16
AC / DC Current Shunt.....	16
AC Wall Adapter.....	14
Accessory Cable Set.....	15
ACF .....	49
Addition of new features.....	55
ADVANCED ANALYZER FEATURES & FUNCTIONS.....	47
Advanced Voltmeter.....	16
ALARM SETTING .....	29, 35
ALARM SETTINGS.....	39
ALARMS.....	29
Algorithm Calibration Factor.....	47, 49
ANALYZER / IBMS INTERACTION .....	55
Analyzer Kit .....	13
Analyzer Recovery .....	57
Analyzer Restore.....	57
ANALYZER SETUP .....	18
AUTO CALIBRATION .....	54
AUTO SHUTDOWN .....	23
Autobaselining.....	47
Auto-Calc Strap Reference .....	50
AUTO-CALCULATED-STRAP REFERENCE..	50
auto-calibration.....	20
Automobile Inverter .....	15
AUTO-START DELAY (SEC).....	28, 35

### B

BASELINE ACF .....	47
Baseline Adjustment .....	49
BASELINE IMP. REF. (mΩ).....	47
BASELINE TEMP. (°C or F) .....	47
Baseline Utility .....	47
BASELINING – ANALYZER (BASELINE UTILITY) .....	47
Batteries.....	18
battery acid .....	12
BATTERY DETAILS .....	27, 34
BATTERY REPLACEMENT UTILITY.....	52
BATTERY TYPE .....	27, 34
BATTERY TYPES.....	26, 38

### C

Calibration / Certification.....	16
CAPACITY .....	27, 34
CAUTION.....	8, 9, 11
Caution Symbols.....	9
CAUTIONS .....	11
CD-ROM .....	i
CD-Roms .....	i
CE .....	4
CELSCAN ALARMS .....	30, 36
CELScan™ – Sulfation / Dryout: EC1000™ Upgrade .....	16
CELScan™ Package .....	14
CHECMICAL PROPERTIES .....	51

Coefficient of Variation .....	51, 52
Compact Disc .....	15
Companion Software .....	14
COMPANY / REGION .....	32
Company/Region .....	32
CONNECT TO PC .....	46, 55
CONNECTING .....	46
Connections.....	18
CONTACT .....	24
COPYRIGHT NOTICE.....	5
Customer Services .....	ii

### D

DECLARATION OF CONFORMITY.....	4
digital .....	17
Disassembling .....	11
DRYOUT (%).....	31, 36

### E

earth ground .....	11
EC1000™ KIT .....	14
EJECT SD CARD .....	55
Electrical Connection.....	18
environmental conditions.....	12
Extended Warranty .....	16

### F

FCC Rules .....	4
FFT .....	17, 51
FIMRWARE .....	24
Firmware.....	1

Firmware Update Error.....57	Keypad.....20	NOISE FILTERING.....28, 34
FIRMWARE UPGRADES .....57	L	noise rejection .....17
Flooded .....27, 34	language .....23	NOTE.....9
G	LANGUAGE .....23	O
Geographical Region .....18	Lead Acid (AGM) .....27, 34	OPTIONAL ACCESSORIES .....15
H	Lead Acid (Gel).....27, 34	Oscilloscope .....16
Hand Strap .....14	Li-Ion .....27, 34, 48	Other.....27, 34
Hard Carrying Case .....15	Linux.....17	P
HARDWARE .....24	Lithium Ion .....27, 34	PC.....11, 46
hierarchy.....18	Lithium-Ion .....14	POLARITY CORRECTION.....35
High Capacity Lithium-Ion Battery Pack .....15	LITHIUM-ION .....12	POWER MANAGEMENT .....23
HIGH NOISE .....51	lithium-ion battery.....23	power off.....21
I	Location .....33	Power off.....21
IBMS.....17, 46	Location Hierarchy .....18	precautions .....12
IBMS™ BASELINE ADJUSTMENT .....47	M	PRECAUTIONS.....7, 11
Impedance / Voltage .....24	MAC ADDRESS.....24	Q
IMPEDANCE ALARMS .....29, 35	Main Menu .....21	QUICK TEST SETTINGS .....26
IMPEDANCE HIGH (%) .....29, 35	MAIN MENU .....22	QUICK TESTS.....22
IMPEDANCE LOW (%).....30, 35	MANUFACTURER.....27, 34	R
Infrared .....14	MASTER RESET .....54	recovery .....21
Infrared Thermometer .....55	MINI SD CARD .....24	Relative Degradation .....48
Inventory Management .....19	Mini SD Memory .....14	Repair .....ii
K	MODEL .....24, 27, 34	REPEATABILITY UTILITY .....51
Kelvin clips .....11	N	REPEATABILITY UTILITY.....51
Kelvin Clips.....14	Needs Testing.....52	Replacement Teeth .....15
Kelvin Probes - Double Point .....15	Nickel Cadmium.....27, 34	Replacement Tips.....15
Kelvin Probes – Mini .....15	Nickel Metal Hydride .....27	Representative or Distributor.....ii
Kelvin Probes – Single Point.....15	NiMH .....48	S
keypad.....20	Noise Filtering .....51	SAFETY .....10, 11

SAFETY INSTRUCTIONS .....	6	Sulfation / Dryout .....	24	Trademarks.....	5
Screen layout .....	21	SUPPORT .....	24	TROUBLESHOOTING .....	57
SD Card.....	22	Synchronization of the Clock .....	55	TYPE .....	27, 34
SD Card Reader.....	15	SYSTEM DIAGNOSTICS .....	55	U	
SERIAL NUMBER.....	24	System Profile Screen .....	23	UNPACKING .....	13
Service .....	i	System Settings Menu .....	23	Update of firmware .....	55
Setup Methods .....	19	T		upgrade.....	16
SHIFT .....	26	TABLE OF CONTENTS.....	1	UPS .....	51
Shoulder Strap .....	14	technical specification .....	63	USB Cable .....	14
Site Location.....	18	Technology Overview .....	17	USB Connection .....	46
Site Name.....	19	TEMPERATURE FORMAT .....	23	USE AUTO-CALC BASELINE.....	47
sites .....	19	TEST CONFIGURATION .....	25	UTILITIES MENU .....	18
Soft Carrying Case .....	14	TEST CONFIGURATIONS .....	25	Utility Menu .....	23
software.....	i	TEST DRYOUT.....	29, 37	V	
SOUND AND DISPLAY .....	23	TEST IMPEDANCE .....	28, 37	VERSION RELEASE DATE .....	24
SPECIFICATIONS .....	58	TEST LEVEL.....	27, 34	VOLT. REF. (BATTERY)(V) .....	31, 37
STD. ACF. REF. VALUE.....	31, 38	TEST RESULTS .....	44	VOLT. REF. (CELL)(V).....	31, 37
STD. IMP. REF. VALUE (mΩ) .....	31	TEST SETTINGS.....	39	VOLTAGE ALARMS.....	30, 36
STRAP ALARMS .....	31, 37	TEST START .....	28	VOLTAGE HIGH (V).....	30, 36
String .....	18	TEST SULFATION.....	28, 37	VOLTAGE LOW (V).....	30, 36
String configuration .....	33	TEST VOLTAGE.....	28, 37	W	
String Configuration .....	19	TESTING .....	25, 41	WARNING .....	8, 9, 11
STRING CONFIGURATIONS .....	32	TESTING USING THE ANALYZER.....	41	WARNINGS .....	9, 11
String Name .....	19	Thermocouple Probe Module .....	16	warranty .....	i
String selection.....	33	TIME AND DATE .....	23	WARRANTY .....	i
SULFATION (%) .....	30, 36	TOOLS.....	18, 47	welcome.....	20

## APPENDICES

[NONE]